HOLDEN BEACH TERMINAL GROIN PDT MEETING

September 6, 2012

APPLIED TECHNOLOGY & MANAGEMENT

Marina, Coastal, Environmental
& Water Resources Engineers

Project Purpose

To implement an erosion control and beach/dune restoration that will provide short and long-term protection for threatened residential structures, Town infrastructure, and recreational assets along the east end of Holden Beach.

Project Needs

-To maintain and promote a recreational beach area
-To maintain and promote public parking and access points
-To preserve the tax base
-To help maintain the island's tourist industry
-To complement the existing island wide nourishment protection activities.

Alternatives

1) No Action

2) Abandon/Relocation

3) Inlet Relocation with Beach Nourishment

4) Terminal Groin Structure with Beach Nourishment

5) Beach Nourishment only with various borrow sites

OUTLINE

-Project Site

-Borrow Areas

-Alternatives

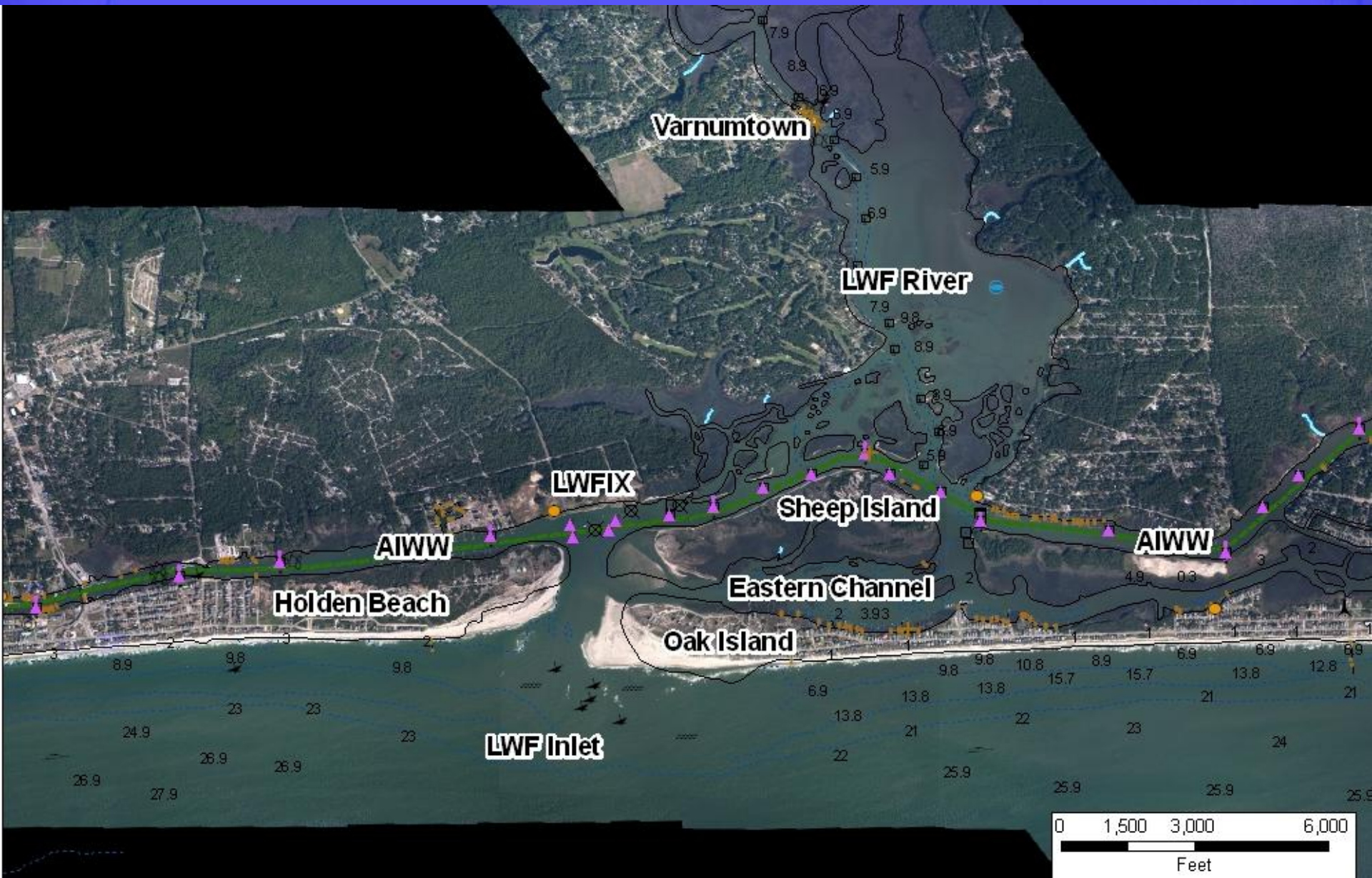
-Modeling of Alternatives

Holden Beach

←Net Transport

Sand Starved Offshore

General Location Map



East End Street Names

ONGOING HB BEACH MANAGEMENT ACTIVITIES

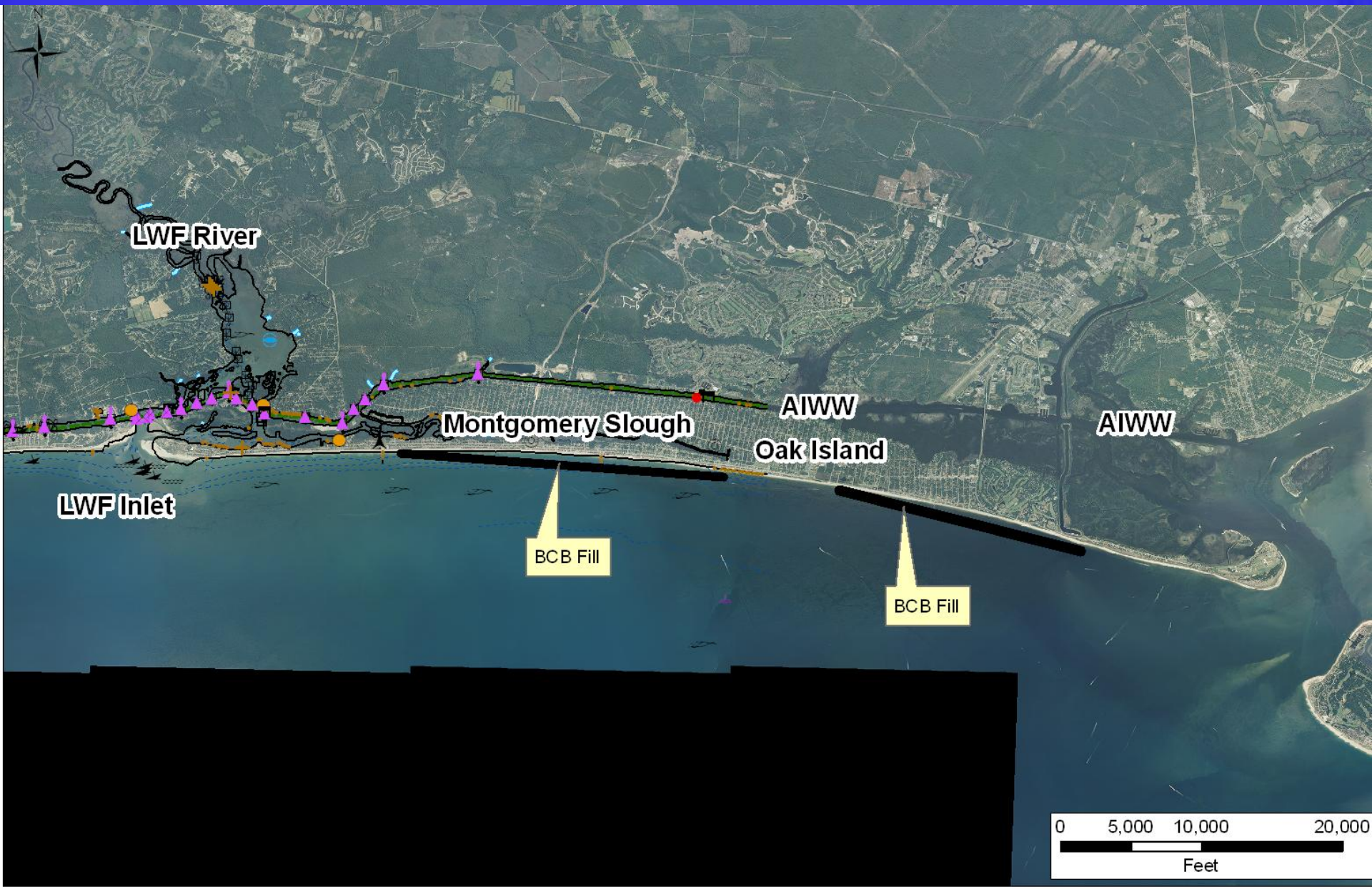
- Central Reach Permitting
- Terminal Groin/East End Project
- FEMA Hurricane Irene
- Annual Monitoring Data Collection & Reporting

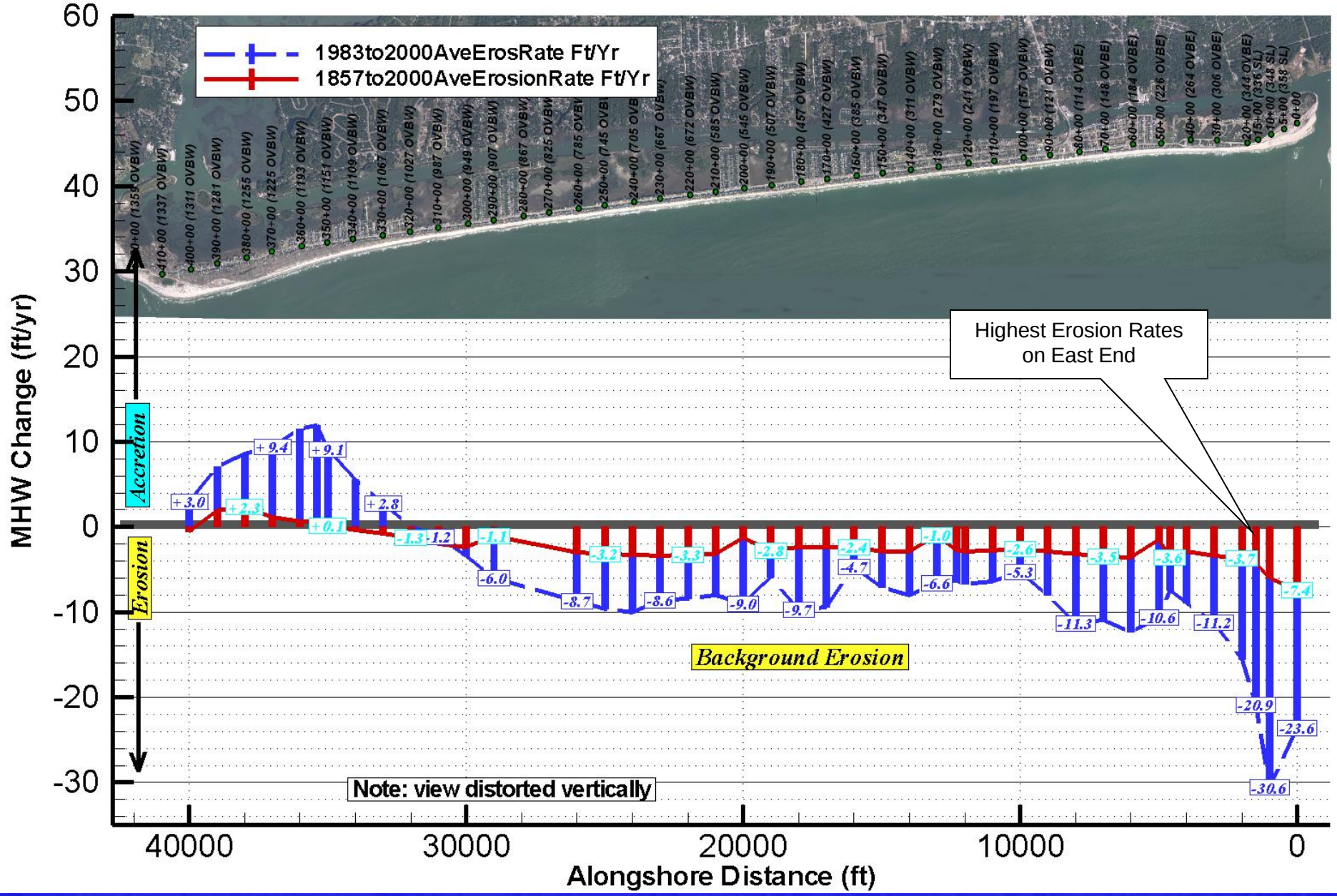
FEDERAL PROJECTS

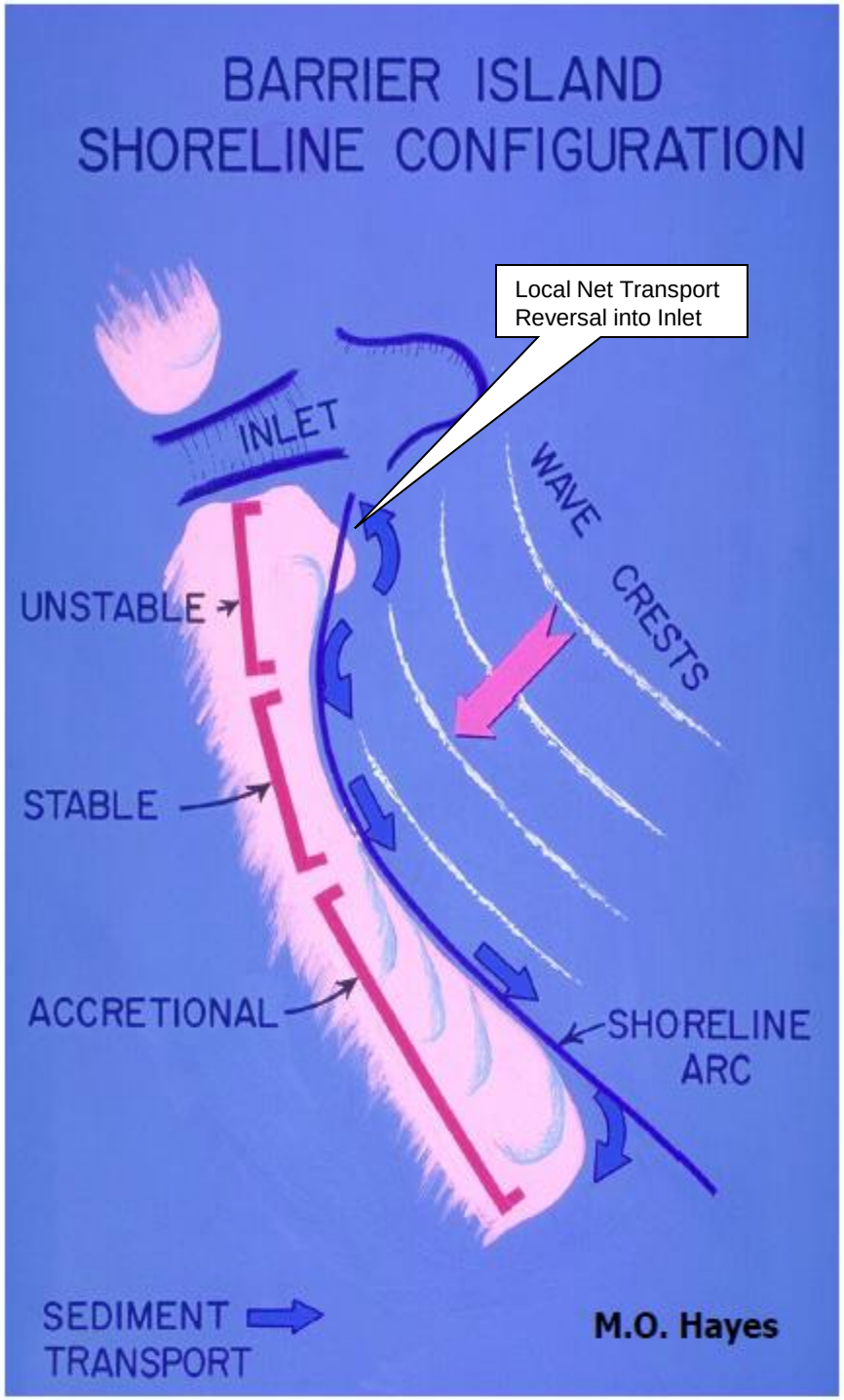
- AIWW Dredging/Placement
- BCB 50 Year Project
- LWF Outer Channel Dredging (Sidecaster, Murden)

2000 to 2012 Activities

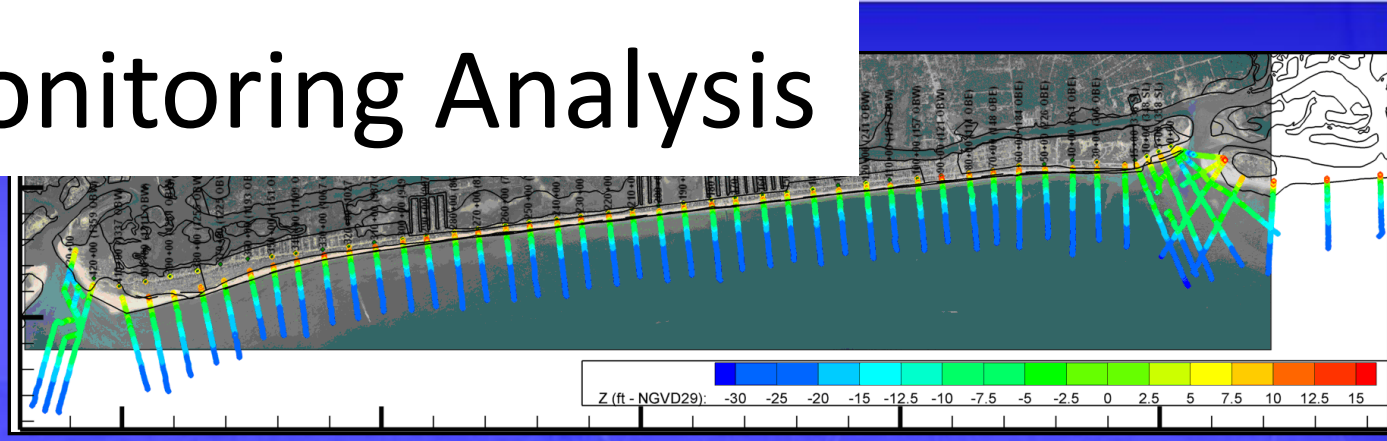
Oak Island Fill Activities




1983to2000AveErosRate Ft/Yr
1857to2000AveErosionRate Ft/Yr
Highest Erosion Rates on East End
Accretion
Erosion
Background Erosion
Note: view distorted vertically
MHW Change (ft/yr)
Alongshore Distance (ft)
60
50
40
30
20
10
0
-10
-20
-30
40000
30000
20000
10000
0
+3.0
+2.3
+9.4
+9.1
+0.1
+2.8
-1.3
-1.2
-1.1
-6.0
-8.7
-3.2
-8.6
-3.3
-9.0
-2.8
-9.7
-2.4
-4.7
-1.0
-6.6
-2.6
-5.3
-11.3
-3.5
-10.6
-3.6
-11.2
-3.7
-20.9
-30.6
-23.6
-7.4


BARRIER ISLAND
SHORELINE CONFIGURATION
Local Net Transport
Reversal into Inlet
INLET
WAVE
CRESTS
UNSTABLE
STABLE
ACCRETIONAL
SHORELINE
ARC
SEDIMENT
TRANSPORT
M.O. Hayes

Annual Monitoring Analysis



- Volume Change
- Shoreline Change
- Has occurred annually since 2001
- Nourishment Planning & FEMA Eligibility

Figure 39. Photographs of the eastern portion of Holden Beach. **A**. West view (3/86) of eroding shoreline and houses stranded on recreational beach. Note bulkheads, timber groins and vestiges of seawalls that litter the beach. The eastern portion of Holden Beach shoreline near the inlet has been a chronic erosion zone since the late 1970s. **B**. West view (11/7/97) of same area in "**A**" retreat of the shoreline, removal of all but one home and a refurbished dune/dike composed of truck hauled sand. **C**. Aerial photograph of house on beach and peat exposure. Insert depict dike along road. **D.** Aerial photograph depicting shoreline and chronic erosion zone. Note the homes fronted by bulkheads and remnants of those destroyed.

Existing Monitoring

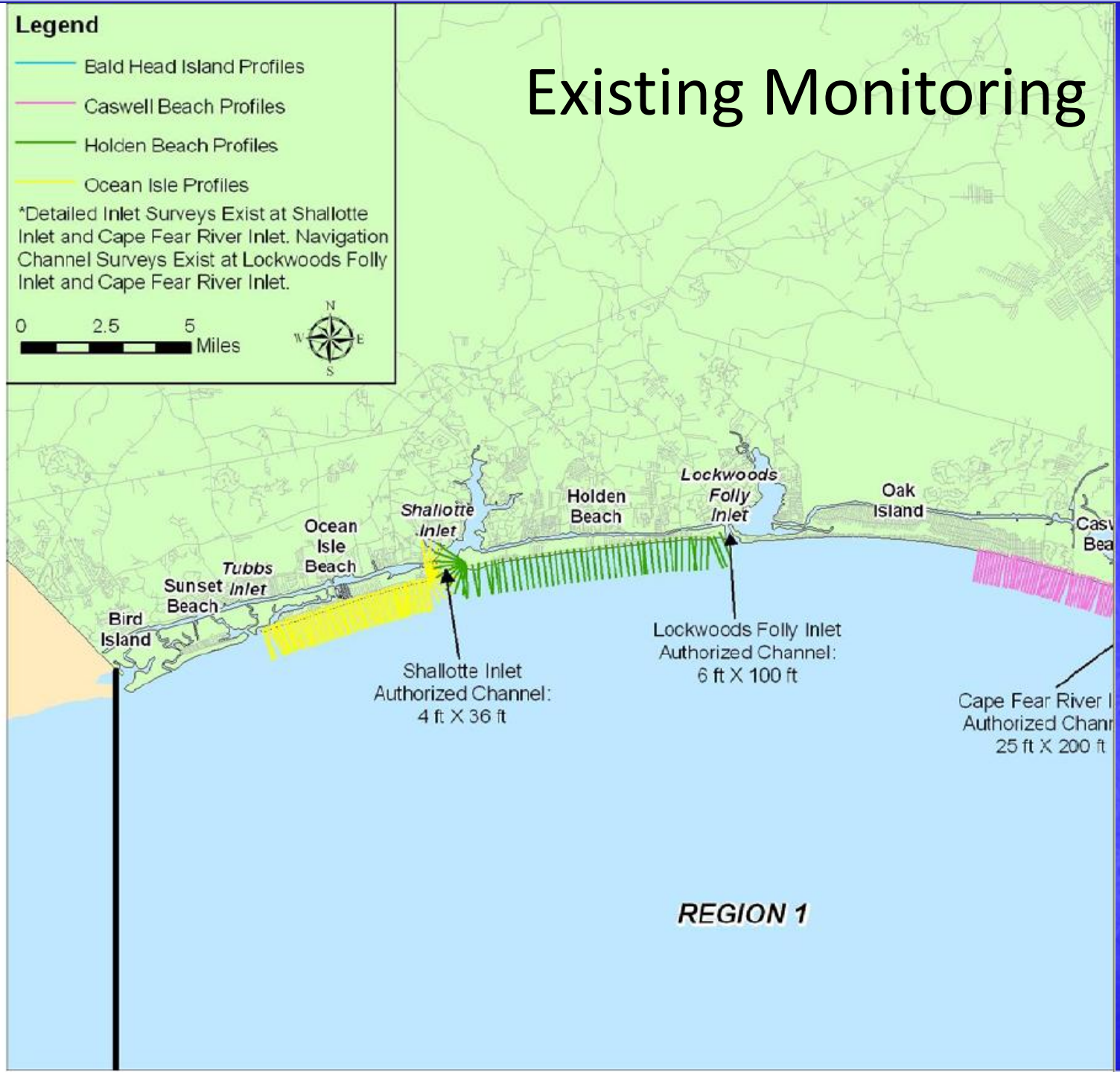
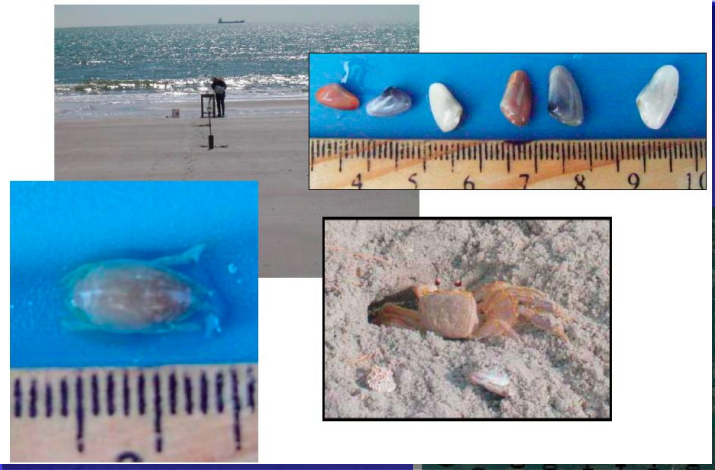
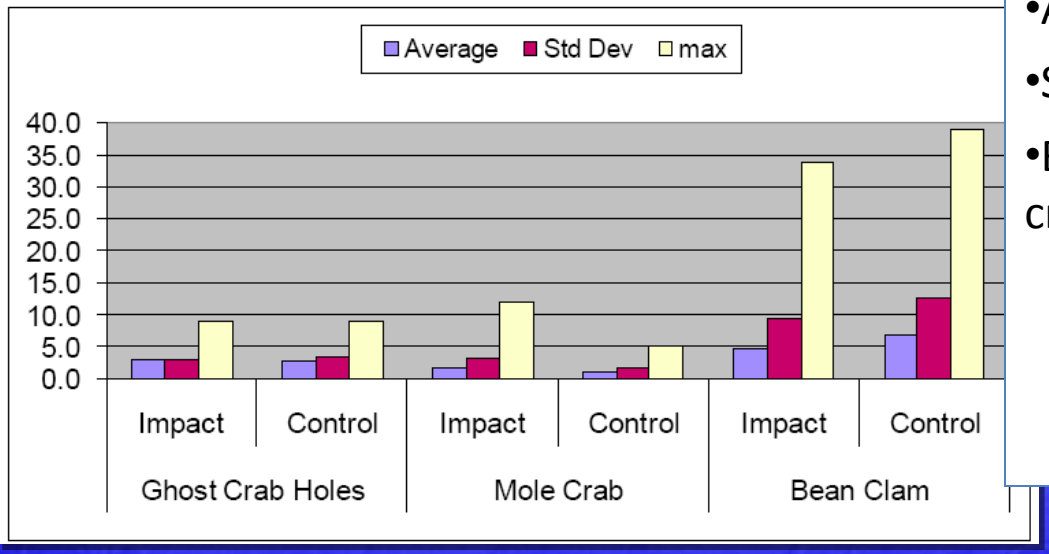


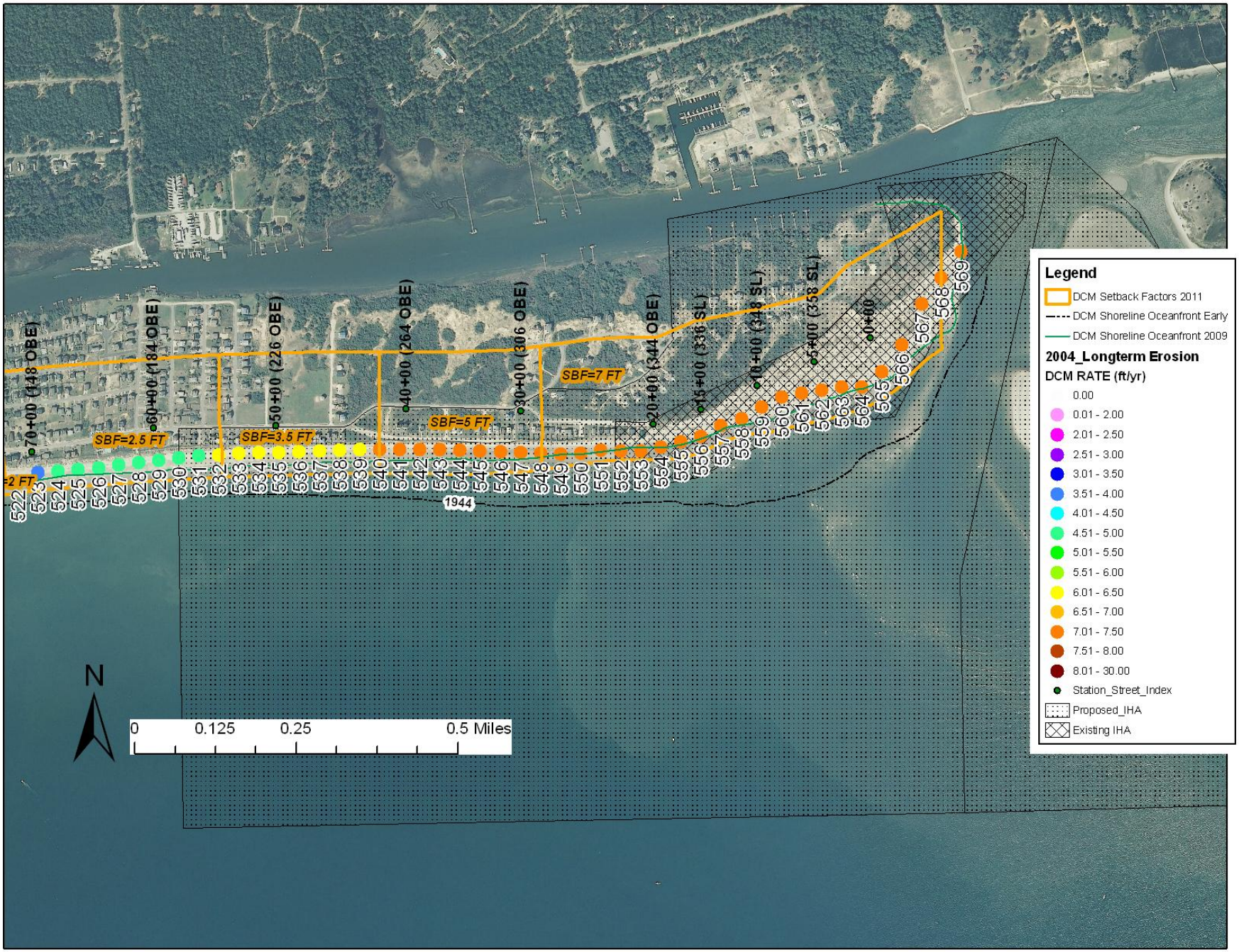
Figure VIII-8. Beach Profile Monitoring Locations for Region 1

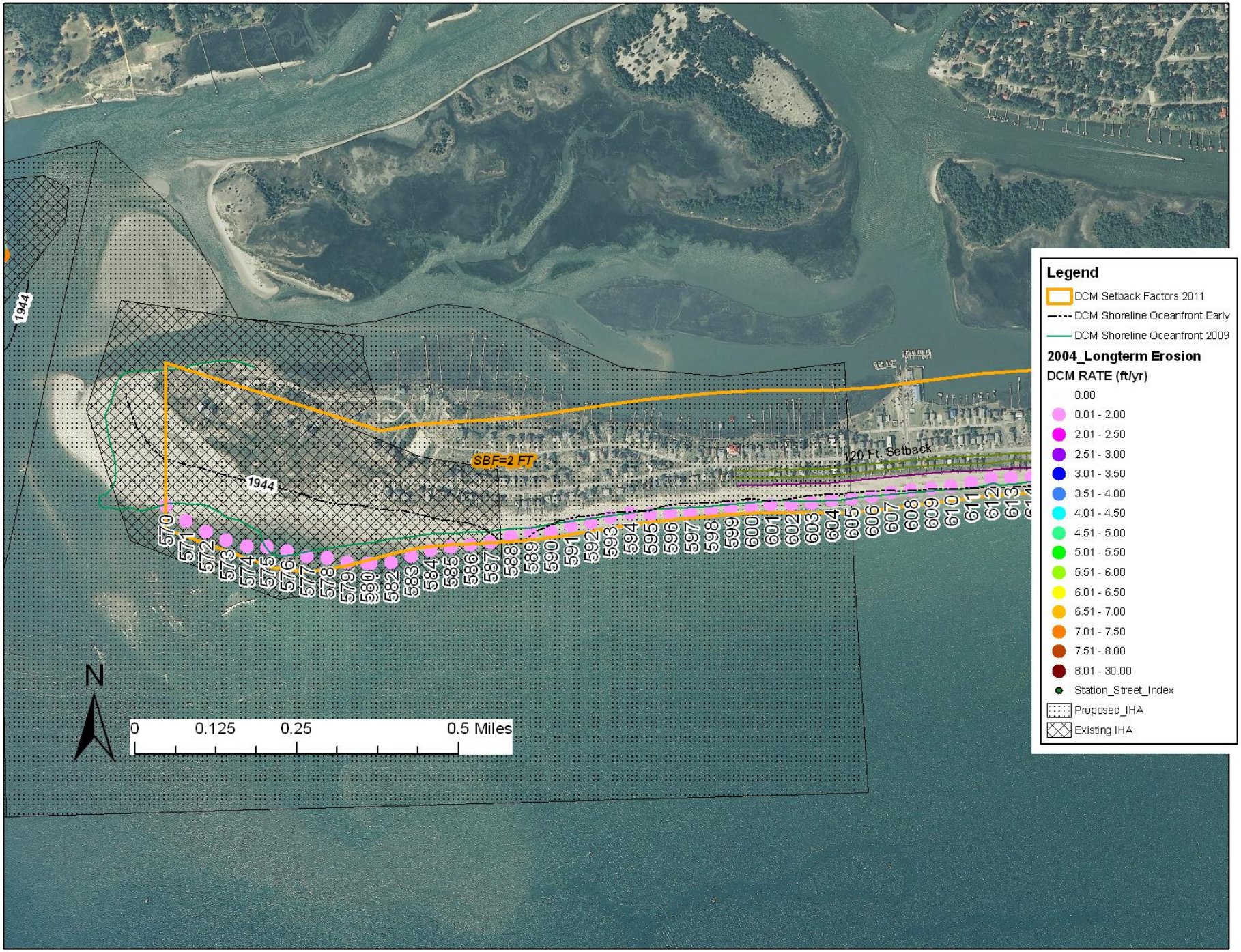
Existing Biological Monitoring



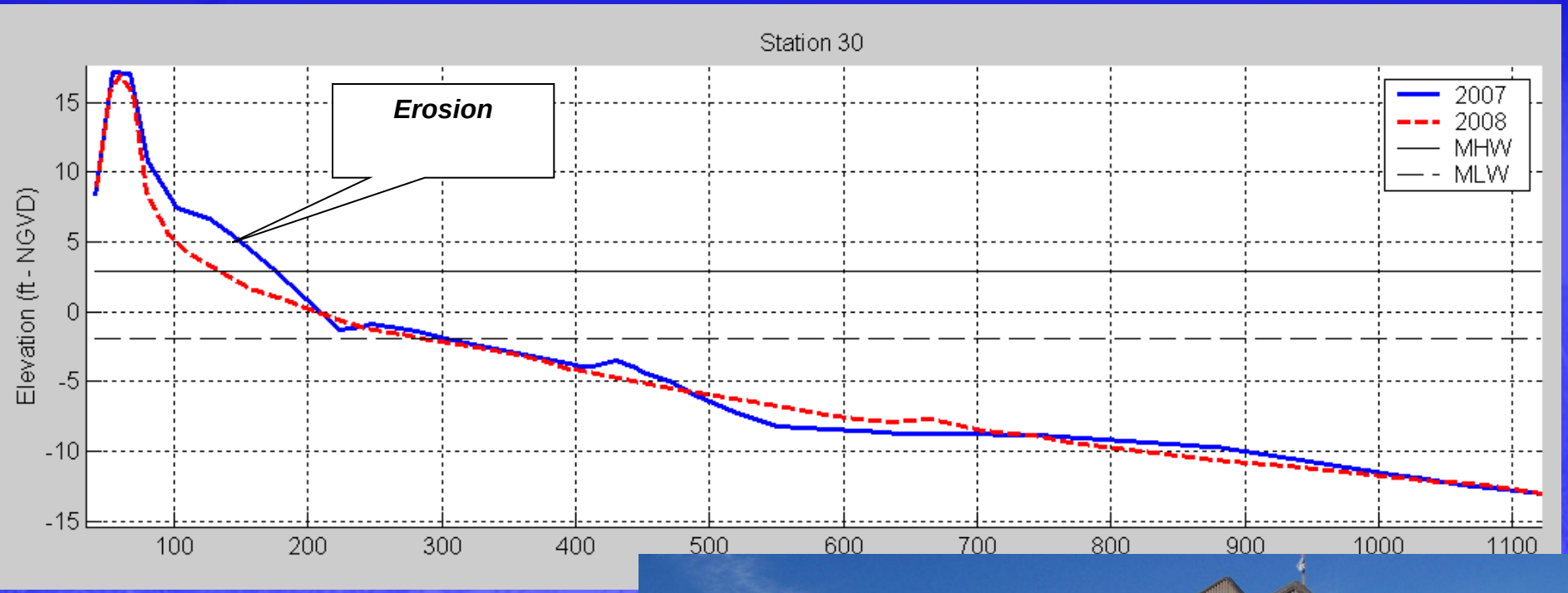


- Annual beach surveys
- Sediment compatibility analysis
- Biological monitoring for bean clams, mole crabs and ghost crab holes.


Legend
DCM Setback Factors 2011
DCM Shoreline Oceanfront Early
DCM Shoreline Oceanfront 2009
2004_Longterm Erosion
DCM RATE (ft/yr)
0.00
0.01 - 2.00
2.01 - 2.50
2.51 - 3.00
3.01 - 3.50
3.51 - 4.00
4.01 - 4.50
4.51 - 5.00
5.01 - 5.50
5.51 - 6.00
6.01 - 6.50
6.51 - 7.00
7.01 - 7.50
7.51 - 8.00
8.01 - 30.00
Station_Street_Index
Proposed_IHA
Existing IHA
N
0
0.125
0.25
0.5 Miles
SBF=2.5 FT
SBF=3.5 FT
SBF=5 FT
SBF=7 FT
70+00 (148 OBE)
60+00 (184 OBE)
50+00 (226 OBE)
40+00 (264 OBE)
30+00 (306 OBE)
20+00 (344 OBE)
15+00 (336 SL)
10+00 (348 SL)
5+00 (358 SL)
0+00
1944

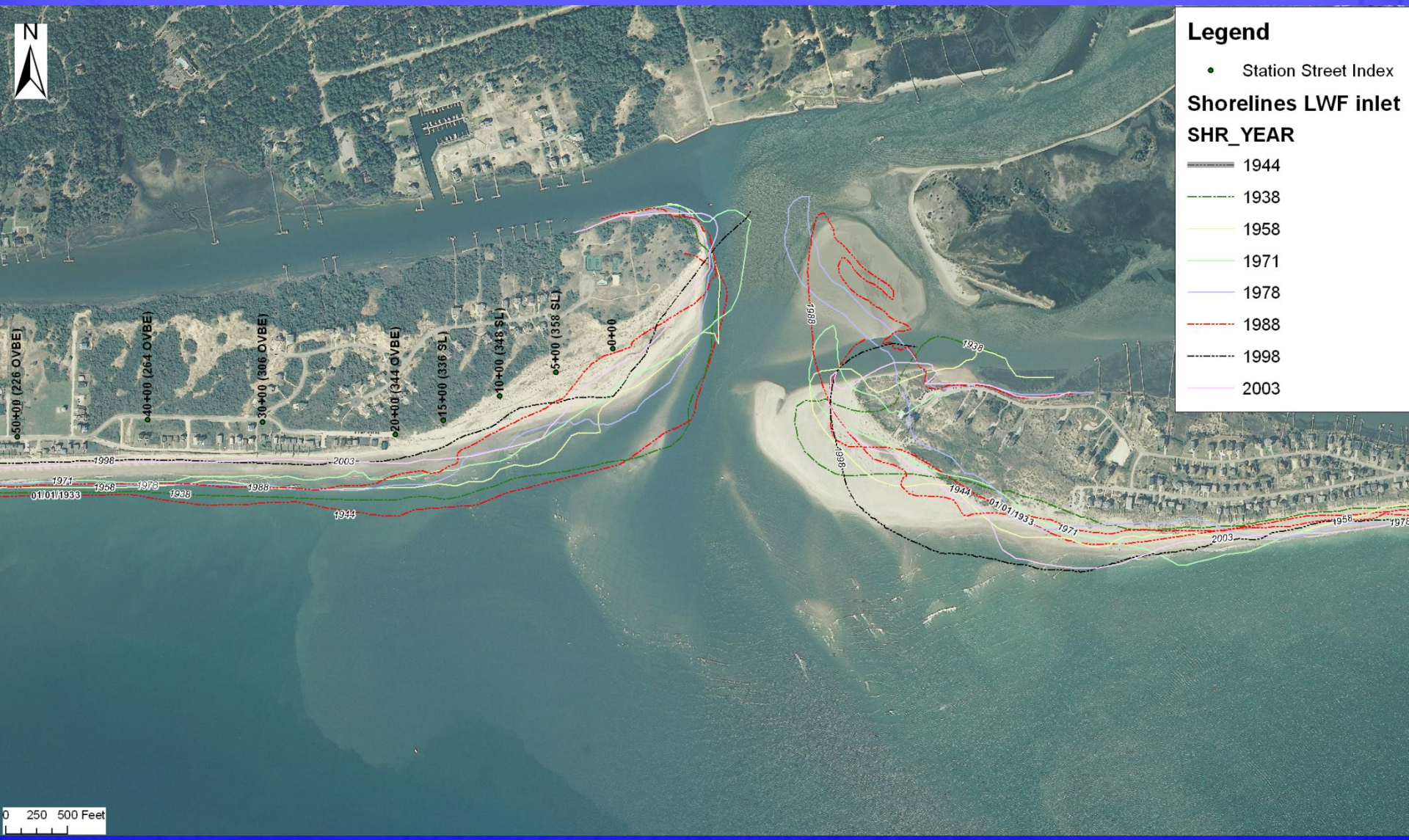

Legend
DCM Setback Factors 2011
DCM Shoreline Oceanfront Early
DCM Shoreline Oceanfront 2009
2004_Longterm Erosion
DCM RATE (ft/yr)
0.00
0.01 - 2.00
2.01 - 2.50
2.51 - 3.00
3.01 - 3.50
3.51 - 4.00
4.01 - 4.50
4.51 - 5.00
5.01 - 5.50
5.51 - 6.00
6.01 - 6.50
6.51 - 7.00
7.01 - 7.50
7.51 - 8.00
8.01 - 30.00
Station_Street_Index
Proposed_IHA
Existing IHA
SBF=2 FT
120 Ft. Setback
1944
1944
N
0
0.125
0.25
0.5 Miles

Hurricane/TS Hanna

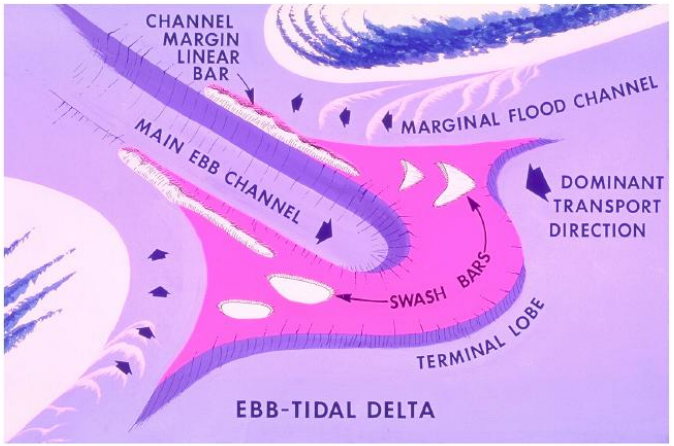


Station	Unit Volume Change due to September 2008 Storms
	(cy/ft)
15+00	-1.6
20+00	-21.2
30+00	-5.3
40+00	-12.3

Relatively Stable last ~70 years

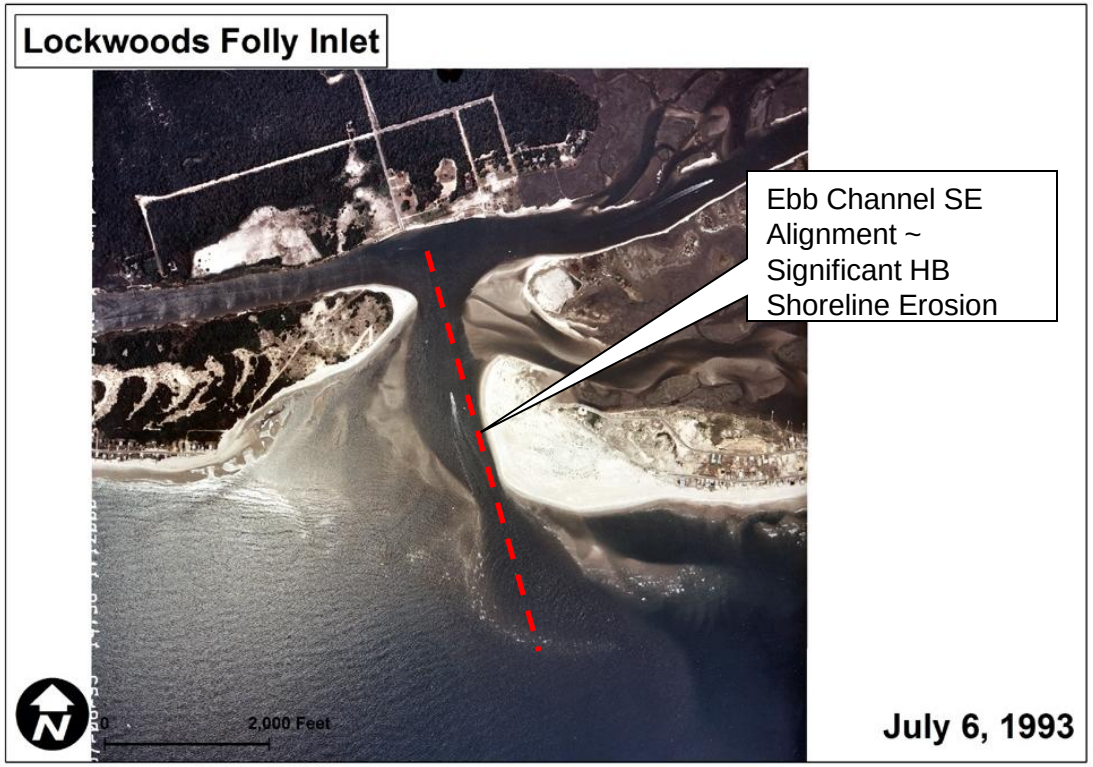


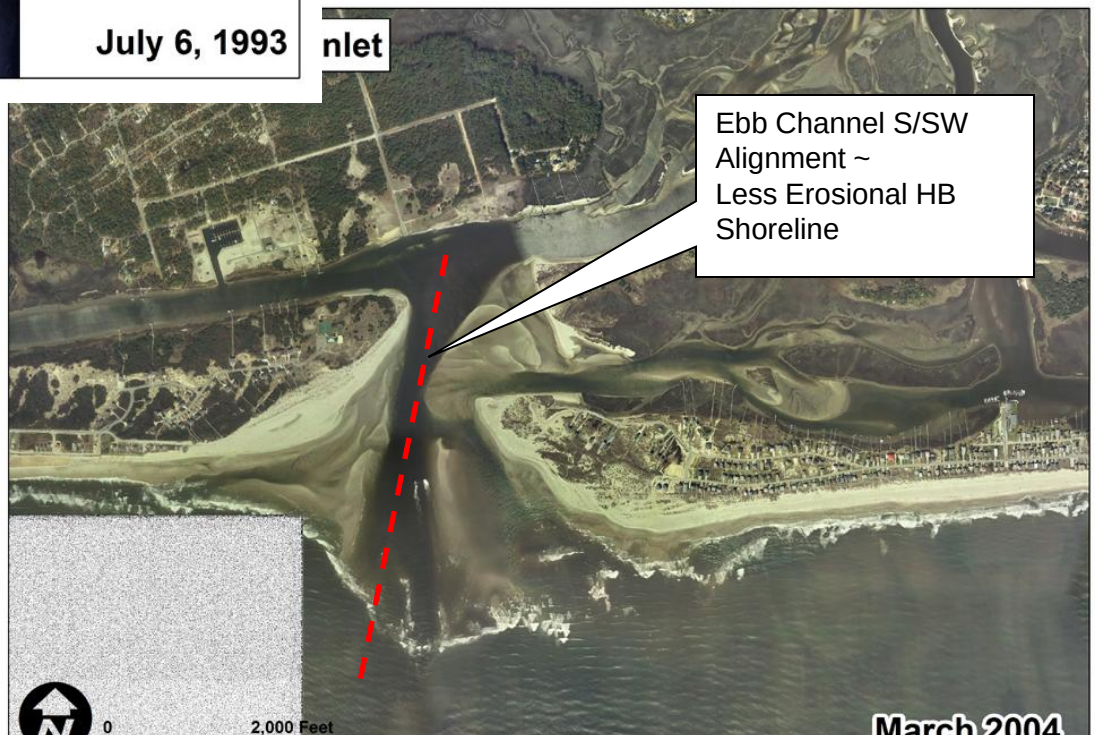
Sediment Transport



Ebb-tidal delta model. By M.O. Hayes.

Project History (2000-2010)





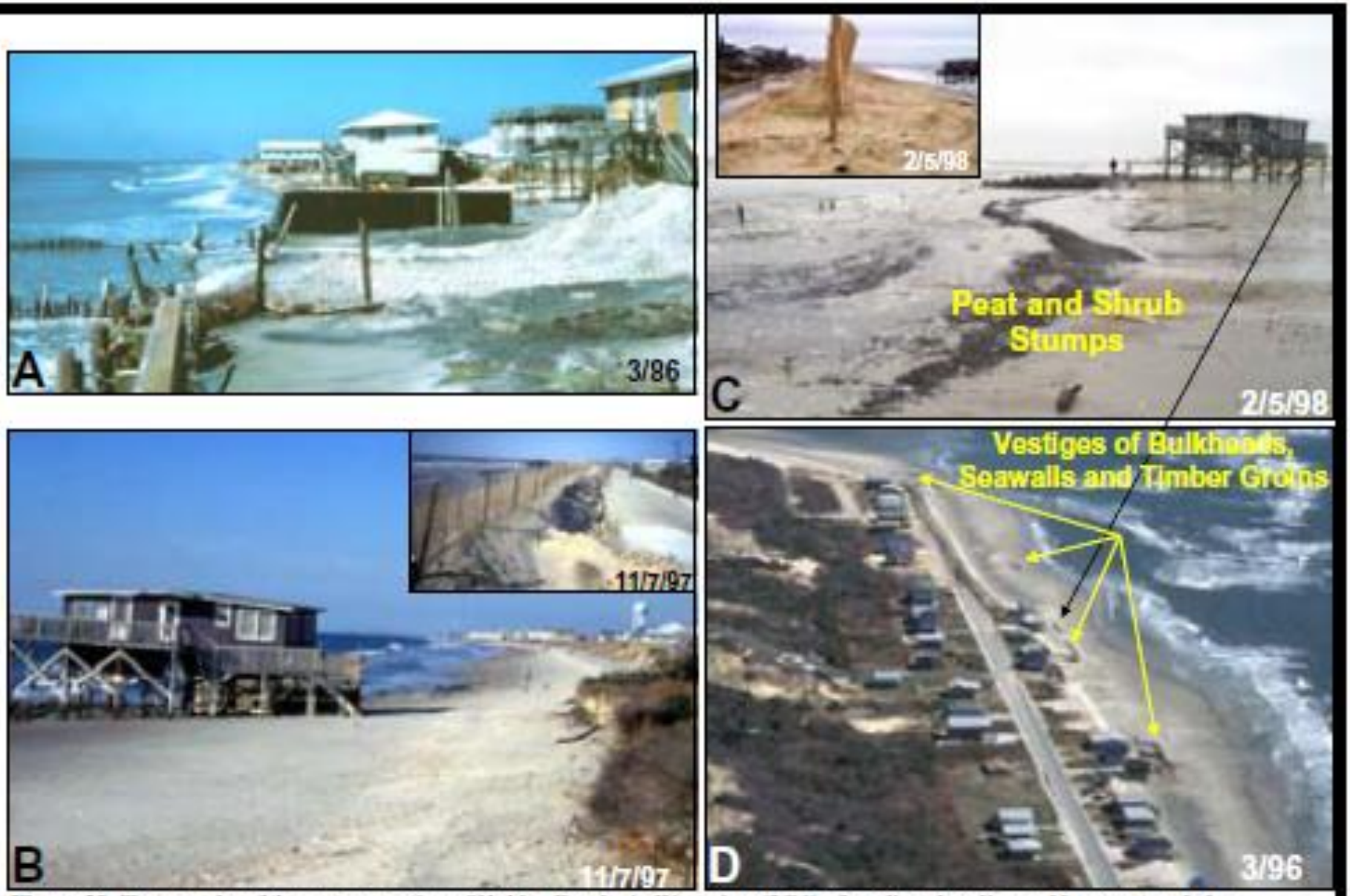
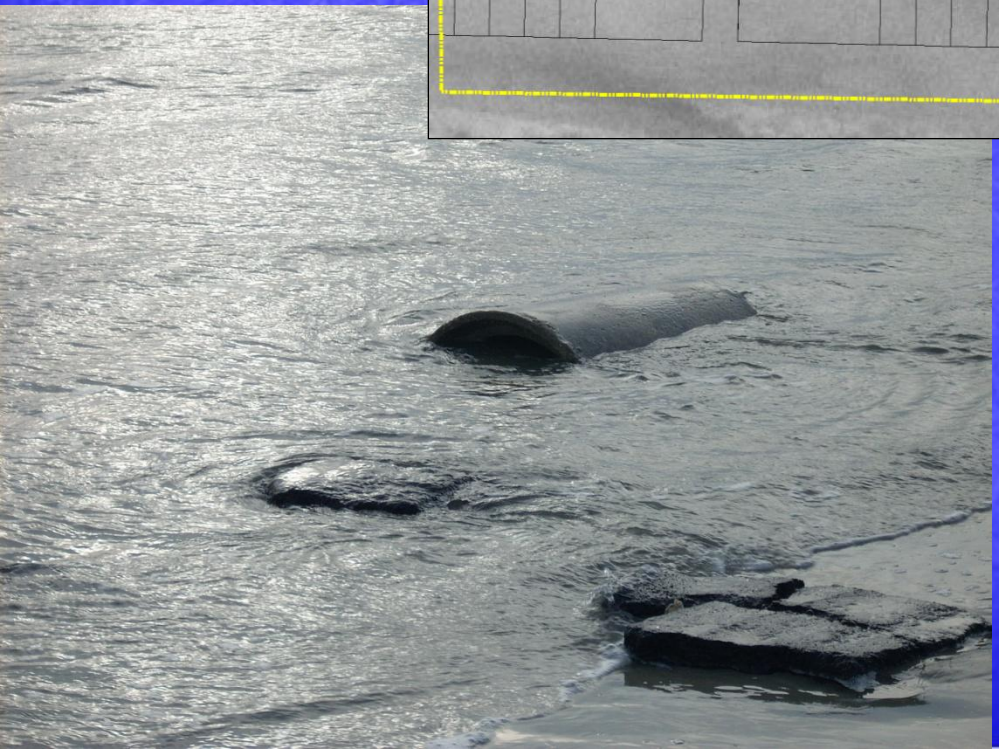


Figure 39. Photographs of the eastern portion of Holden Beach. **A.** West view (3/86) of eroding shoreline and houses stranded on recreational beach. Note bulkheads, timber groins and vestiges of seawalls that litter the beach. The eastern portion of Holden Beach shoreline near the inlet has been a chronic erosion zone since the late 1970s. **B.** West view (11/7/97) of same area in "**A**" retreat of the shoreline, removal of all but one home and a refurbished dune/dike composed of truck hauled sand. **C.** Aerial photograph of house on beach and peat exposure. Insert depict dike along road. **D.** Aerial photograph depicting shoreline and chronic erosion zone. Note the homes fronted by bulkheads and remnants of those destroyed.

1990's

N
Legend
2010_MHW
2008 MHW
Station Street Index
0+00 (344 OVBE)
15+00 (336 SL)
10+00 (348 SL)
Abandoned/Destroyed Homes

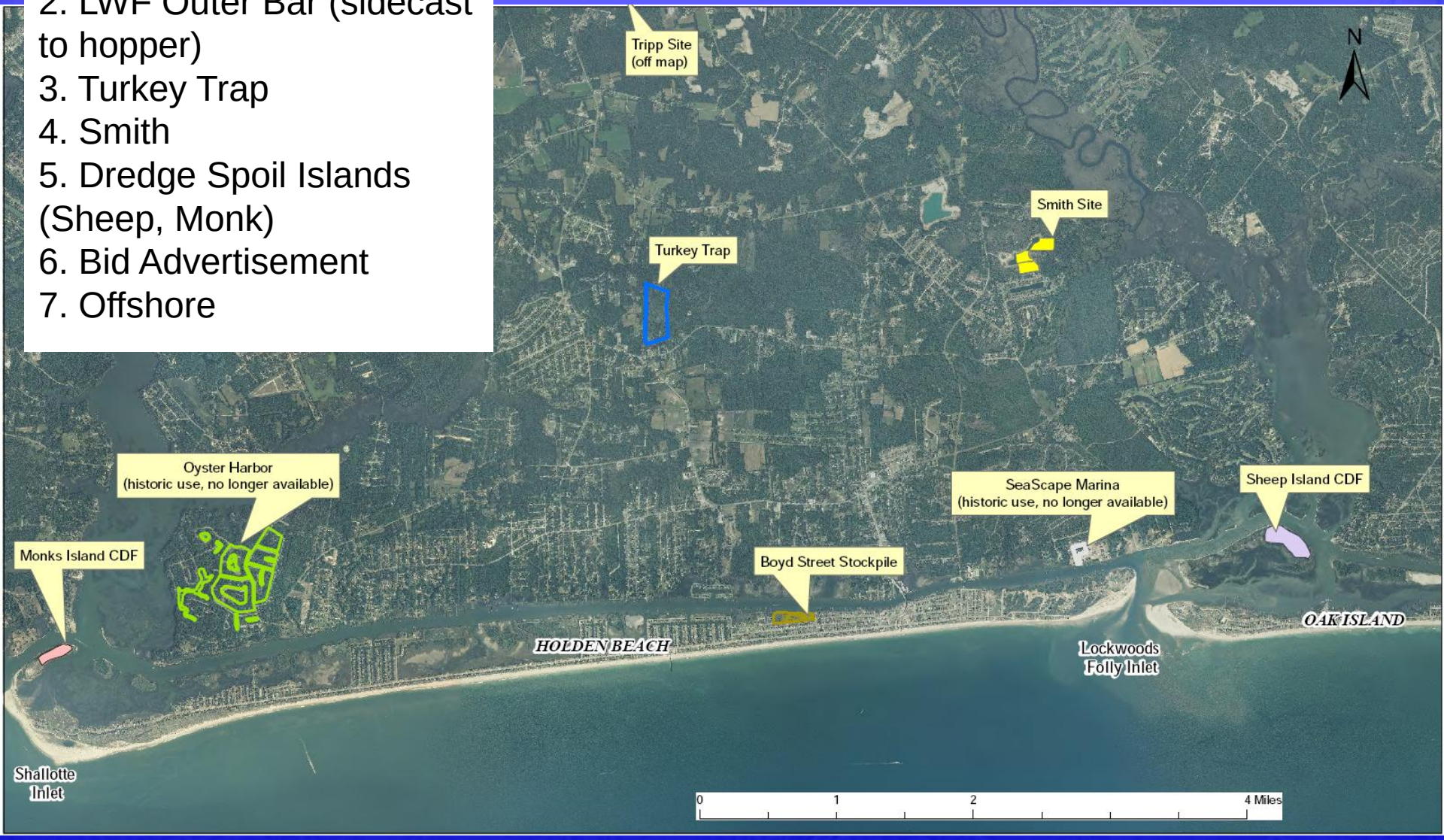


BORROW AREA ALTERNATIVES

1. UPLAND
2. DREDGE SPOIL ISLANDS
3. LWF INLET
4. OFFSHORE

Potential and Historic Borrow Areas

SAND SOURCES
1. LWF Inlet (AIWW)
2. LWF Outer Bar (sidecast to hopper)
3. Turkey Trap
4. Smith
5. Dredge Spoil Islands (Sheep, Monk)
6. Bid Advertisement
7. Offshore

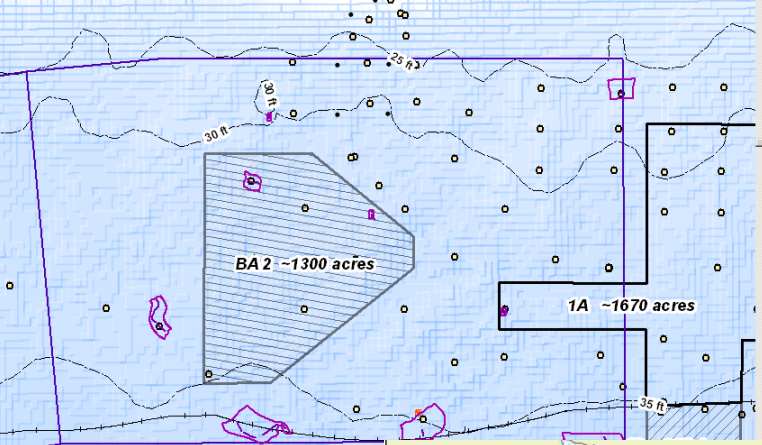


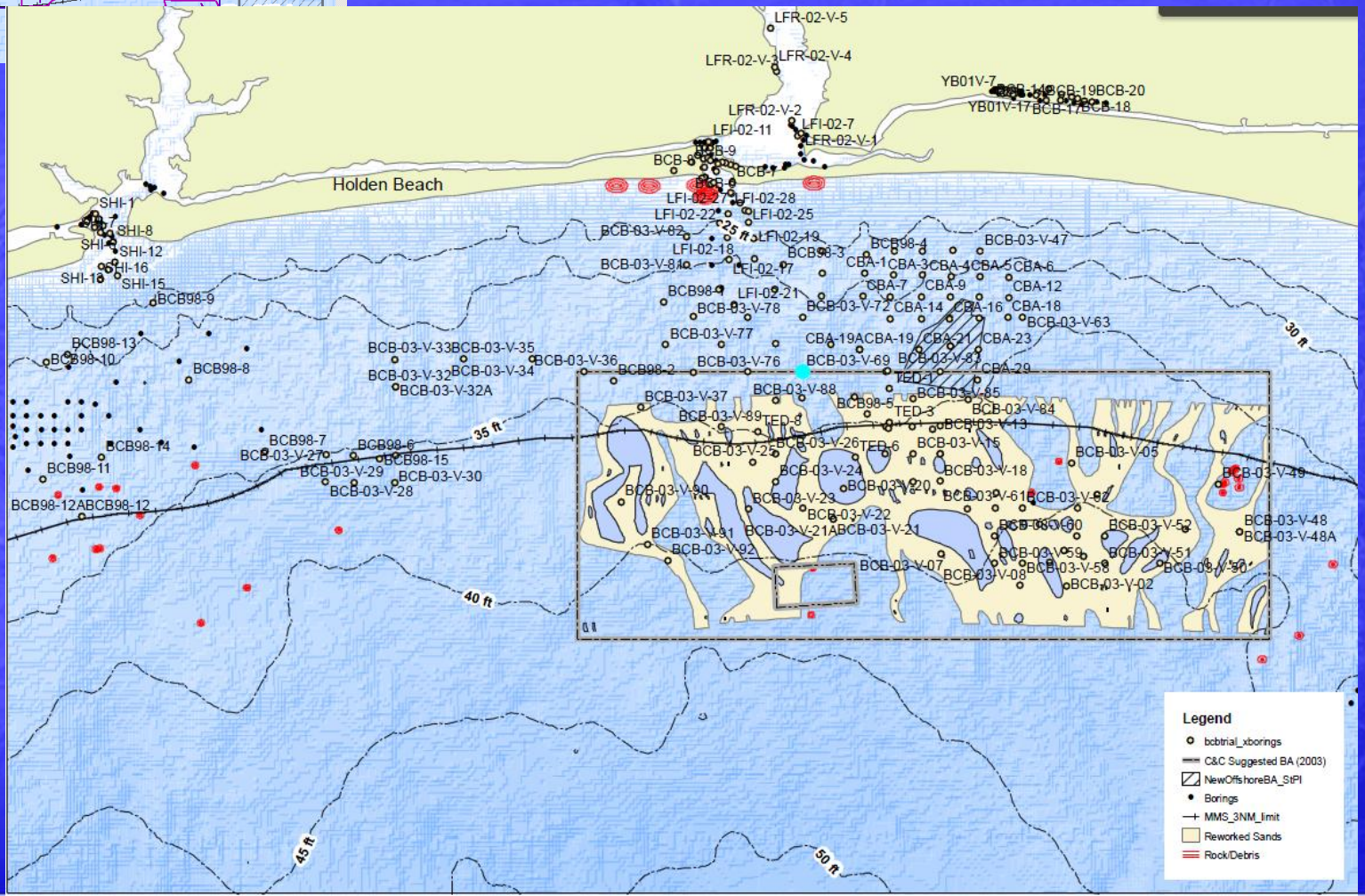
OFFSHORE DATA RESOURCES USED:

1. USACE Vibracores (1990's and 2000's)
2. C&C 1999 Seismic/Subsurface Investigation
3. C&C 2003 Seismic/Subsurface Investigation
4. Artificial Reef Locations
5. NCDENR CHPP (based on 1995 unpublished data, and 2001 Seamap)
6. NCDENR Biological/Wildlife Diversity data (2012)
7. Sonographics Seismic/Subsurface Investigation (2010)
8. Tidewater Atlantic Research (TAR) Seismic, Magetometer, Sidescan Investigation (2011)
9. Athena Vibracore Collection (2010)
10. ARC Surveying high-resolution multi-beam bathymetric data collection (2011)
11. Athena Vibracore Collection (2011)

OFFSHORE

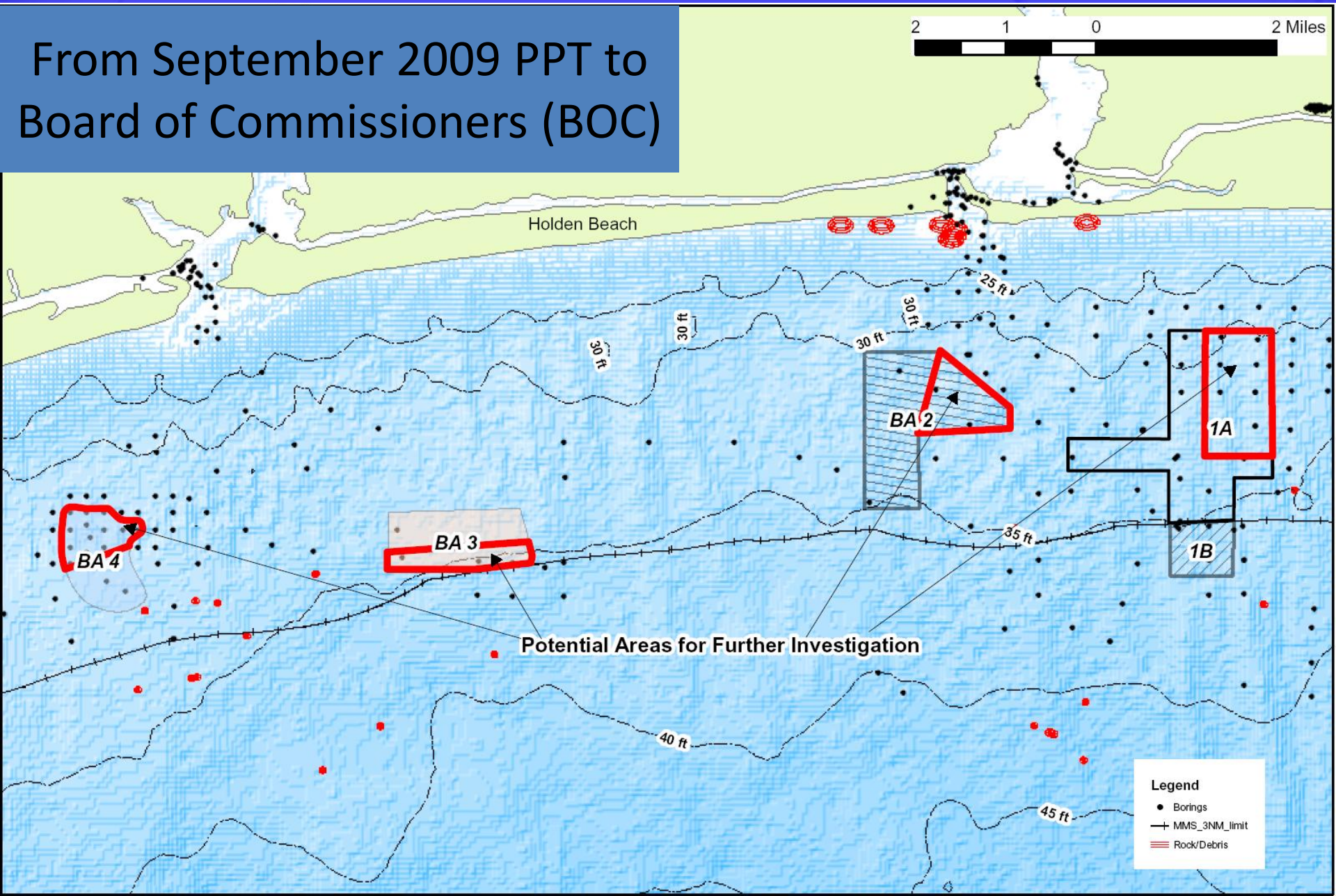
~60 million cy of reworked sediments





OFFSHORE AREAS FOR FURTHER STUDY (ATM, 2009)

From September 2009 PPT to Board of Commissioners (BOC)



NCDENR Data

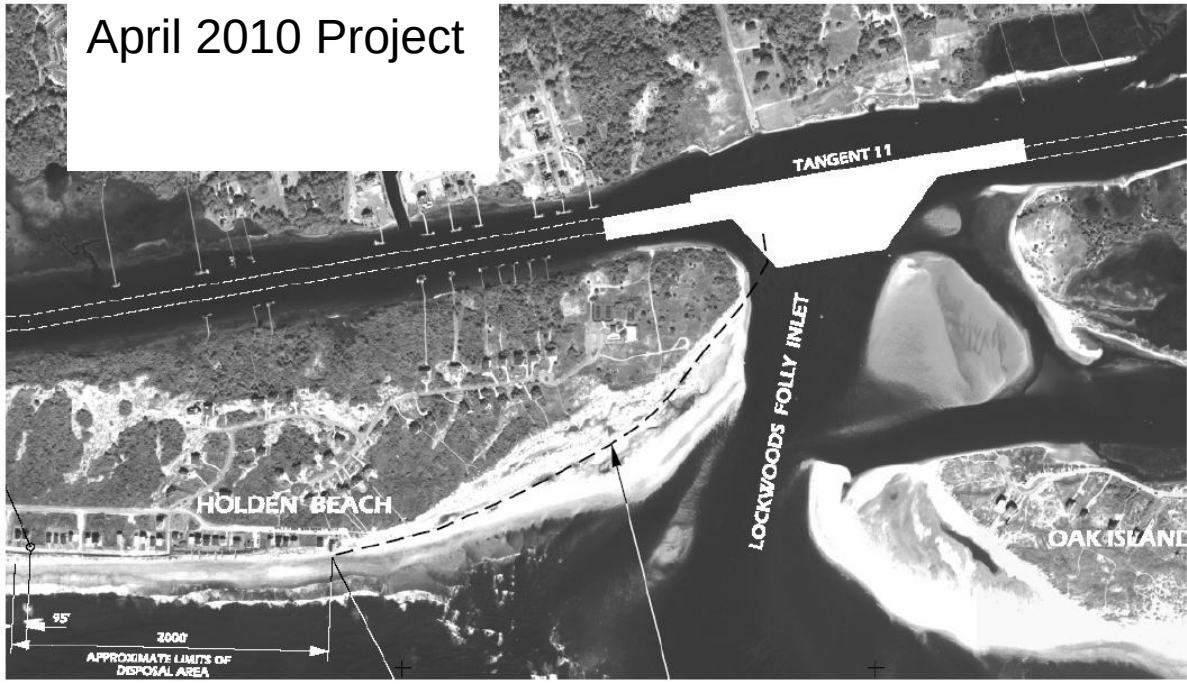
Click on Tools to conver
documents to Word or
Legend
MMS_3nm_UTM
NC Conservation Planning Tool (2012)
Biodiversity and Wildlife Habitat
9; 10 (Maximum Value)
8
7
6
5
2; 3; 4
1 (Moderate Value)
-1 (Impervious Surface)
NewOffshoreBA_StPI
Hardbottom Feature
~1,500 Meters Away
From Proposed Borrow Area
0 500 1,000 2,000 3,000 4,000
Meters

SAND SOURCE

-Same Volume for 2011 & 2012 (~$)

-MOA thru State

-400’ Bend Widener in 2010



Upland Truck Haul Projects

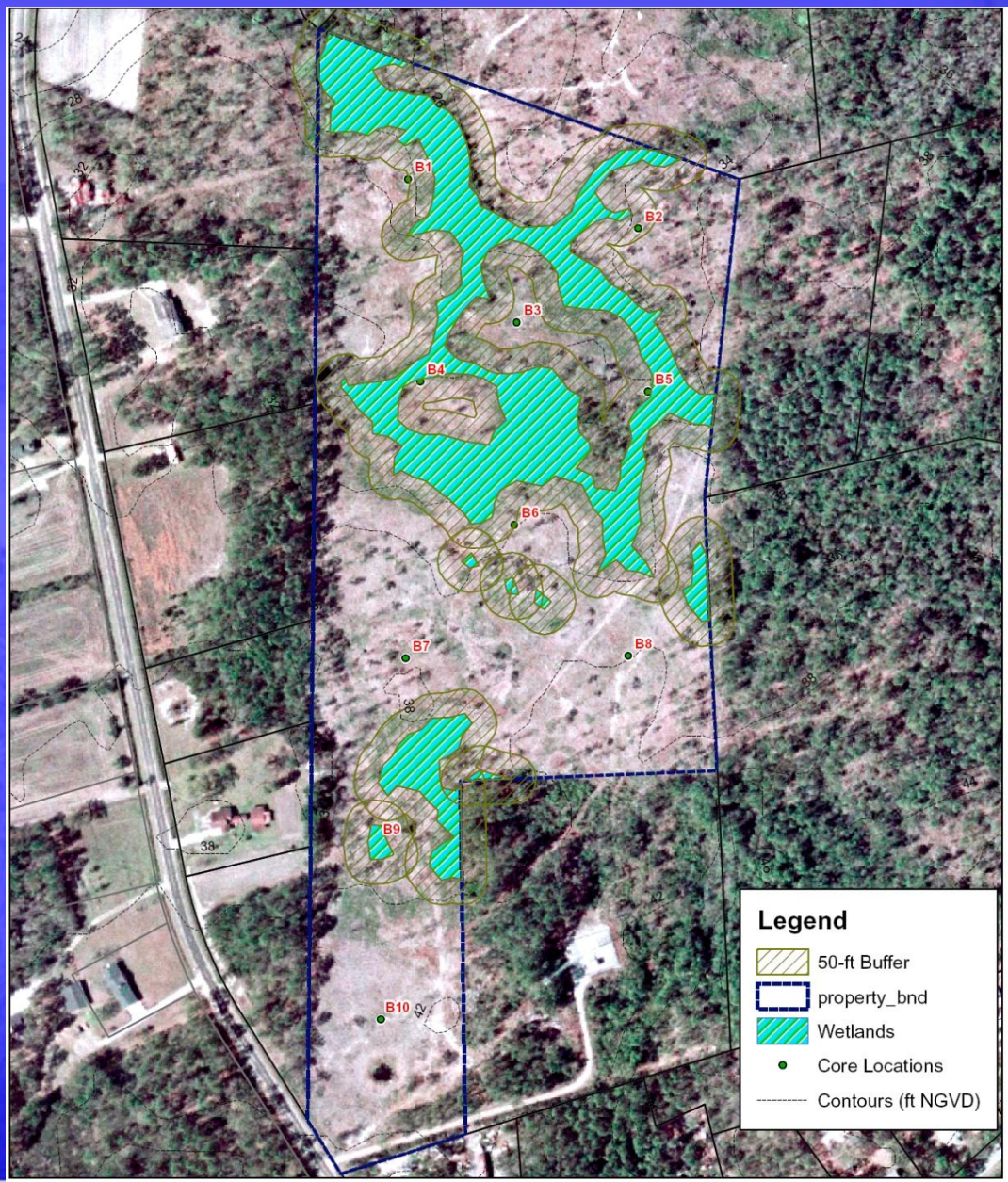
- *Good for medium sized projects (<200,000 cy)*
- *Minor mob/demob costs,*
- *Sand Color typically not as good*
- *Frequency of events*
- *Road Wear, DOT, Bond, etc.*

200,000 cy @ 15 cy/truck = ~14,000 Truck Trips

HB – 2009, 2008, 2006, 2004, 2002

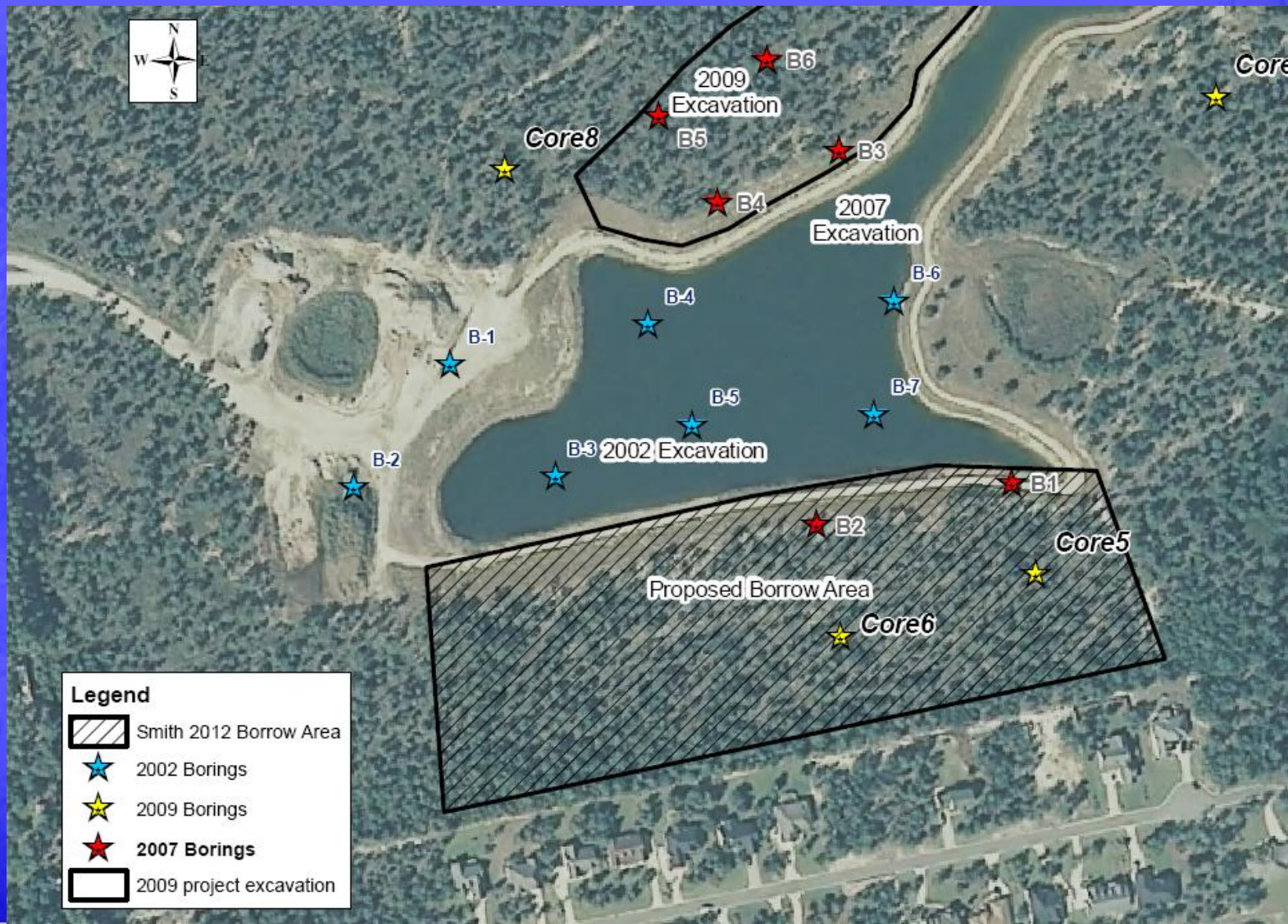
Upland Site: Turkey Trap

- Permitted
- 3.6 mile drive
- HB-owned
- 38 Acres
- Up to ~460,000 cy
- Wetland monitoring



Upland: Smith Site

Permitted, 4.0 mile drive, ~200,000 cy, availability?



Tripp Site

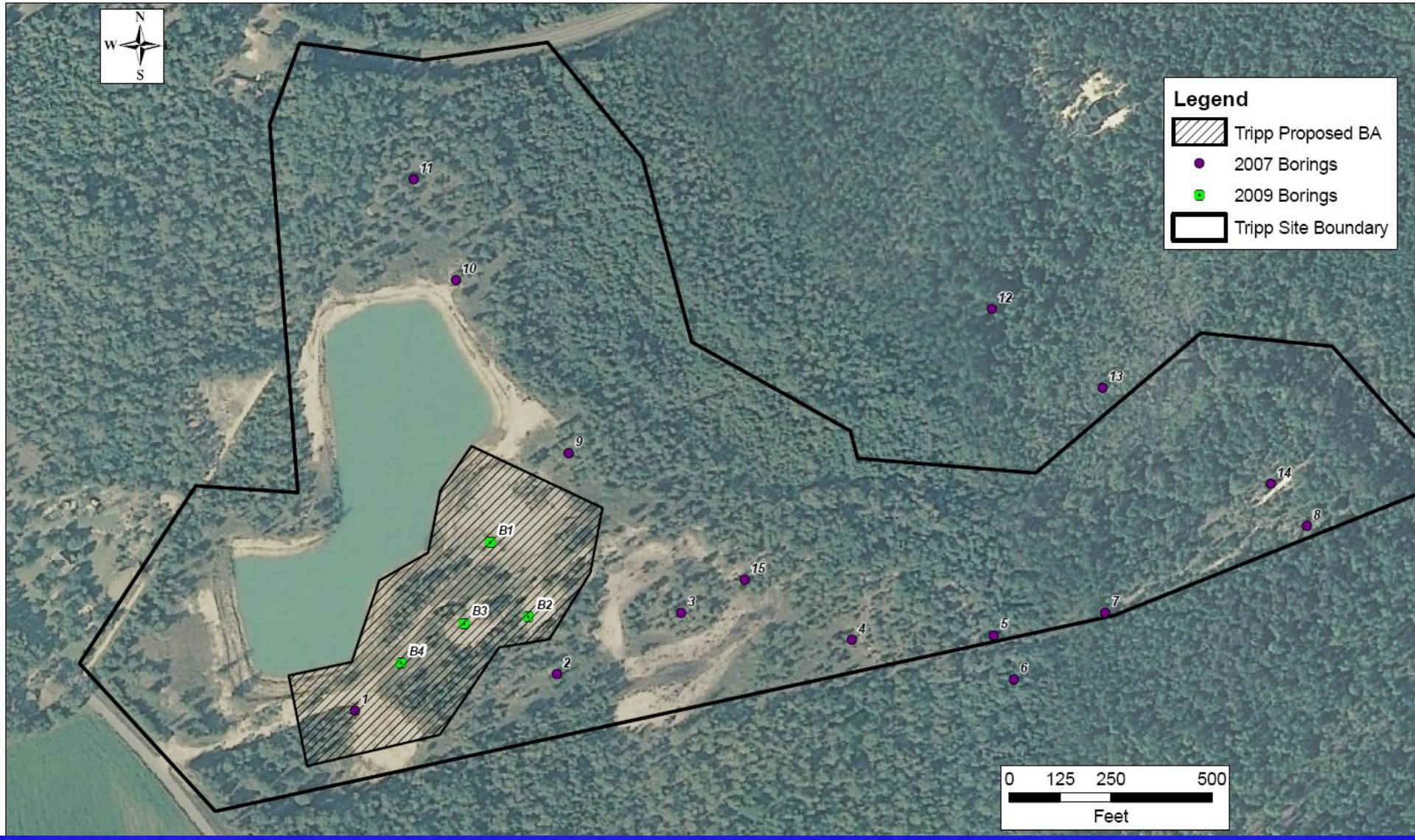

N
W
E
S
Legend
Tripp Proposed BA
2007 Borings
2009 Borings
Tripp Site Boundary
11
10
12
13
9
14
8
B1
15
B3
B2
3
7
4
5
B4
2
6
1
0
125
250
500
Feet

Table 4: Summary of conformance of borrow area alternatives with DCM sediment compatibility criteria

	Mean Ave (mm)	sorting	% Gravel	% Granular	% Fines	% Carbonate
NATIVE BEACH	*0.24*	*0.72*	*0.6*	*n/a*	*2*	*2.7*
DCM Sediment Criteria	*N/A*	*N/A*	*Native + 5%*	*Native + 5%*	*Native + 5%*	*Native + 15%*
DCM Threshold	*N/A*	*N/A*	*5*	*5*	*7*	*17.7*
Offshore Borrow Area	0.35	1.26	2.1	3.4	5.0	12.4
LWF Inlet AIWW	0.41	0.81	2.7	1.1	6.1	10.93
Turkey Trap (Upland)	0.28	0.80	0.0	0.5	1.3	0.00
Smith Site (Upland)	0.34	0.75	0.0	0.1	1.3	0.00
Tripp Site (Upland)	0.17	0.68	0.0	0.2	2.1	0.00

- % 'Gravel' ~= large shells or limestone (e.g., coquina) rock.
- % Granular ~=shell-hash.
- % Fines = clays, etc.
- % Carbonate ~=shell and shell material.

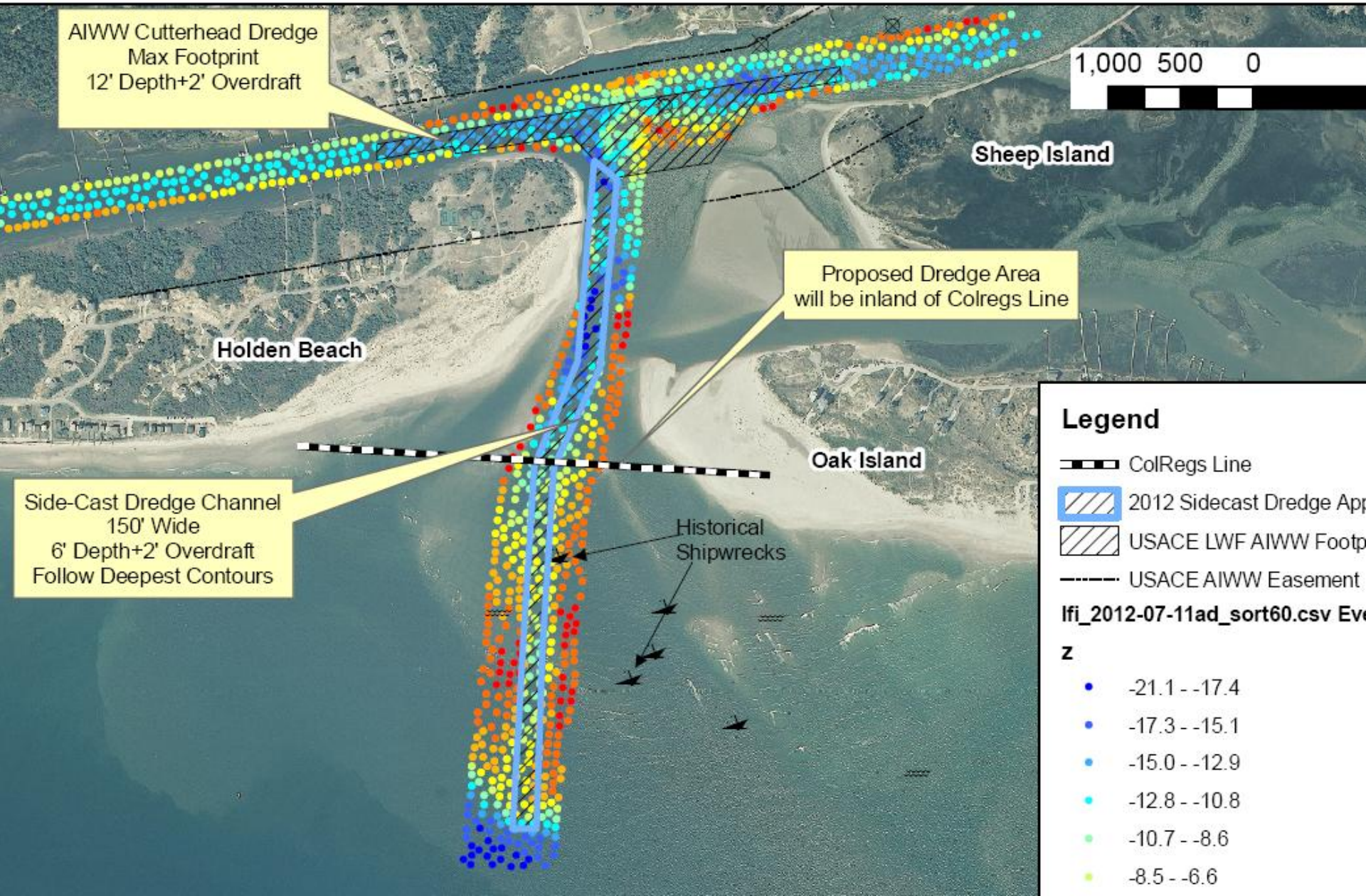
Table 6: Volumes available for borrow area alternatives.

	Volume Available	Reusable
Offshore Borrow Area	>2 million	Maybe
Turkey Trap	460,000	No
Smith Site	250,000	No
Tripp Site	250,000	No
LWF Inlet	100,000	Yes

Table 2: Potential Borrow Area Volumes from 2009 study

Borrow Area	Acreage	Est. Avg. Thickness (ft)	Estimated Yield (cy)
Sheep Island CDF Borrow Area	28	10-20	452,000
Monk Island CDF Borrow Area	10	10-20	161,000
Offshore Borrow Area 1A	1,669	1.5-4	4,039,000
Offshore Borrow Area 1B	268	1.5-4	649,000
Offshore Borrow Area 2	1,103	1.5-3.5	2,669,000
Offshore Borrow Area 3	646	1.5-4	1,563,000
Offshore Borrow Area 4	527	1.5-3	1,275,000
		Total	11,517,000

Preferred Borrow Area



GROINS

National Research Council of the National Academy of Sciences:

RECOMMENDATION: Agencies should modify their prescriptive laws, regulations, and management plans for the coast to allow the use of fixed structures in conjunction with beach nourishment projects where project performance can be significantly improved, out-of-project negative effects are acceptably small or are mitigated as necessary,and beach access or use is not impaired…

NRC Committee Members:

Richard J. Seymour (chair) Texas A&M University and Scripps Institution of Oceanography
Nancy E. Bockstael, University of Maryland, College Park
Thomas J. Campbell, Coastal Planning and Engineering, Inc., Boca Raton, Florida
Robert G. Dean, NAE. University of Florida, Gainesville
Paul D. Komar, Oregon State University, Corvallis
Orrin H. Pilkey, Duke University, Durham, North Carolina
Anthony. P. Pratt, Delaware State, Dept. of Natural Resources
Martin P. Snow, Great Lakes Dredge & Dock Co., Chicago, IL
Robert F. Van Dolah, South Carolina, Dept of Natural Resources
J. Richard Weggel, Drexel University, Philadelphia, PA
Robert L. Wiegel, NAE, University of California, Berkeley

Position Papers For and Against Terminal Groins

Journal of Coastal Research

SPECIAL ISSUE NO. 33 (pages 1–370) WINTER 2004

CONTENTS

Introduction to this Special Issue ..... Nicholas C. Kraus, Kelly L. Rankin 1

Literature Review and Background

Long-Term Effectiveness of a Groin and Beach Fill System: A Case Study Using Shoreline Change Maps ..... Francis A. Galgano Jr. 3

History of the Uniquely Designed Groins Along the Chicago Lakeshore ..... Michael J. Chrzastowski 19

Evolution and Performance of Groins on a Sediment Starved Coast: The Illinois Shore of Lake Michigan North of Chicago, 1880–2000 ..... Charles Shabica, Jason Meshberg, Rita Keefe, and Robert Georges 39

Management

Management and Engineering Guidelines for Groin Rehabilitation ..... Timothy W. Kana, Thomas E. White, and Philip A. McKee 57

The Importance of Aesthetic Aspects in the Design of Coastal Groins ..... Gregorio Gómez-Pina 83

Evaluation of Beach Response to Submerged Groin Construction at Marina di Ronchi, Italy, Using Field Data and a Numerical Simulation Model ..... Pierluigi Aminti, Chiara Cammelli, Lorenzo Cappietti, Nancy L. Jackson, Karl F. Nordstrom, and Enzo Pranzini 99

Design

Groin Functional Design Guidance from the Coastal Engineering Manual ..... David R. Basco and Joan Pope 121

Permeable Wood Groins: Case Study on their Impact on the Coastal System ..... Michael T. Poff, Michael F. Stephen, Robert G. Dean, and Sean Mulcahy 131

Permeable Pile Groin Fields ..... Hans H. Dette, Arved J. Raudkivi, and Hocine Oumeraci 145

Hydraulic Functioning of Permeable Pile Groins ..... Thomas Trampenau, Hocine Oumeraci, and Hans H. Dette 160

Wave Directional Characteristics as a Design Parameter for Groin Performance ..... Hans Hanson and Magnus Larson 188

Case Studies

Experience with Groin Notching Along the Northern New Jersey Coast ..... Kerry Anne Donohue, Lynn Marie Bocamazo, and Daniel Dvorak 198

Isolated Groins at East Hampton, New York ..... Henry Bokuniewicz 215

Medium-Term Bathymetric Change around Jetties at Imagireguchi Inlet, Japan ..... Yoshiaki Kuriyama, Yusuke Uchiyama, Satoshi Nakamura, and Tomokazu Nagae 223

Monitoring and Field Measurements

Nearshore Currents and Sediment Transport Measured at Notched Groins ..... Kelly L. Rankin, Michael S. Bruno, and Thomas O. Herrington 237

Cross-shore Distribution of Alongshore Currents and Sediment Fluxes in the Vicinity of Notched Groins ..... Kelly L. Rankin, Thomas O. Herrington, Michael S. Bruno, Patrick B. Burke, and Anne M. Pence 255

A Continuity Approach to Groin Function and Fillet Angle ..... Craig H. Everts and Carolyn D. Eldon 269

Headlands and Groins: Replicating Natural Systems ..... Gary B. Griggs 280

Design and Construction of a Large Headland System, Keta Sea Defence Project, West Africa ..... Robert B. Nairn and Mohammad Dibajnia 294

Numerical and Physical Modeling

Advancements in One-Line Modeling of T-Head Groins: (Genesis-T) ..... Hans Hanson and Nicholas C. Kraus 315

Modeling and Design of New T-Groins along the Southwest Coast of Florida ..... Mohamed A. Dabees and Kenneth K. Humiston 324

Movable-Bed Model Investigation of Groin Notching ..... Ping Wang and Nicholas C. Kraus 342

2008 USFWS & NMFS Recovery Plan

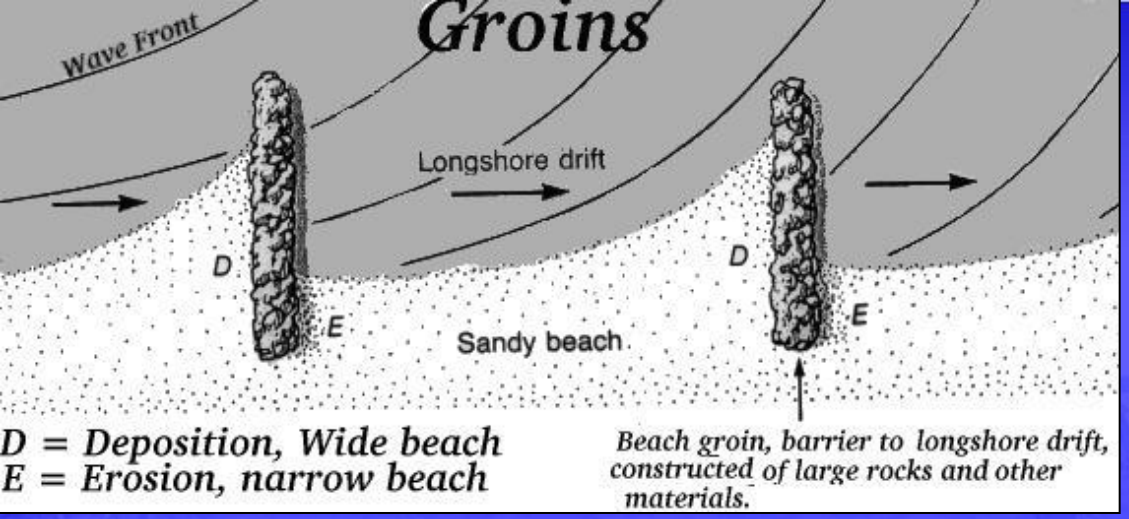
for the Loggerhead NW Atlantic Population

Table A2-3. Results of threats analyses for threat category CONSTRUCTION AND DEVELOPMENT.

Life Stage	Ecosystem	BEACH SAND PLACEMENT	BEACH ARMORING	OTHER SHORELINE STABILIZ- ATION	SAND FENCES	DREDGING	STORM- WATER OUTFALLS	COASTAL CONSTRUCTION	CHANNEL BLASTING	BRIDGE BLASTING	SUM	RRV	TOTAL ESTIMATED ADJUSTED ANNUAL MORTALITY (# OF ADULT FEMALES)
Nesting female	Terrestrial Zone	1	3	1				1			6	1.000	6
Egg	Terrestrial Zone	3,000	30,000	1			1	3,000			36,002	0.004	144
Hatchling stage	Terrestrial Zone	3,000	1	1	1			1			3,004	0.004	12
Swim frenzy, transitional stage	Neritic Zone			1									
Juvenile stage	Oceanic Zone												
Adult stage	Oceanic Zone												
Juvenile stage	Neritic Zone					30							
Adult stage	Neritic Zone					3							
TOTAL ESTIMATED ADJUSTED ANNUAL MORTALITY (# OF ADULT FEMALES)		25	123	1	0	9	0	13					

KEY		
Estimated Annual Mortality	Color Code	Value
No evidence of mortality, based on best available information		
Sub-lethal effects occur at this stage and may result in reduced fitness (e.g., reduced somatic growth rates, reduced hatchling production, reduced prey abundance, reduced quality of nesting and/or foraging habitats)		
> 0 Mortality has been documented or is likely to occur; however, data are insufficient to estimate mortality		1
1-10		3
11-100		30
101-1000		300
1001-10,000		3,000
10,001-100,000		30,000
100,001-1,000,000		300,000

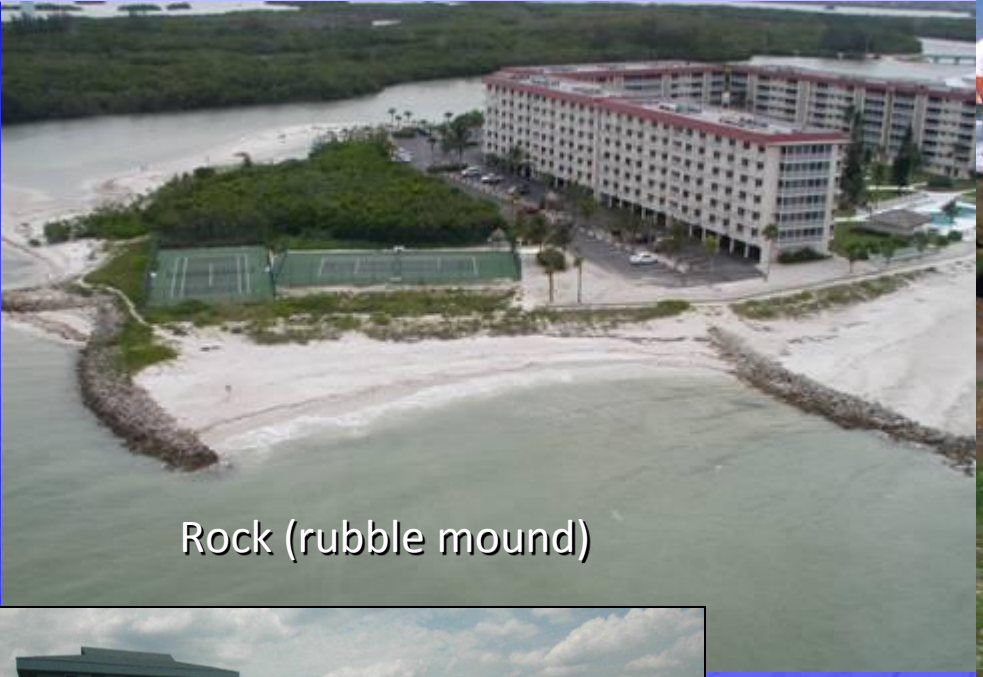
Other shoreline stabilizations	Includes groins, jetties, mesh groins (nets), and offshore breakwaters



Winter/Summer Patterns

Oregon Inlet Terminal Groin

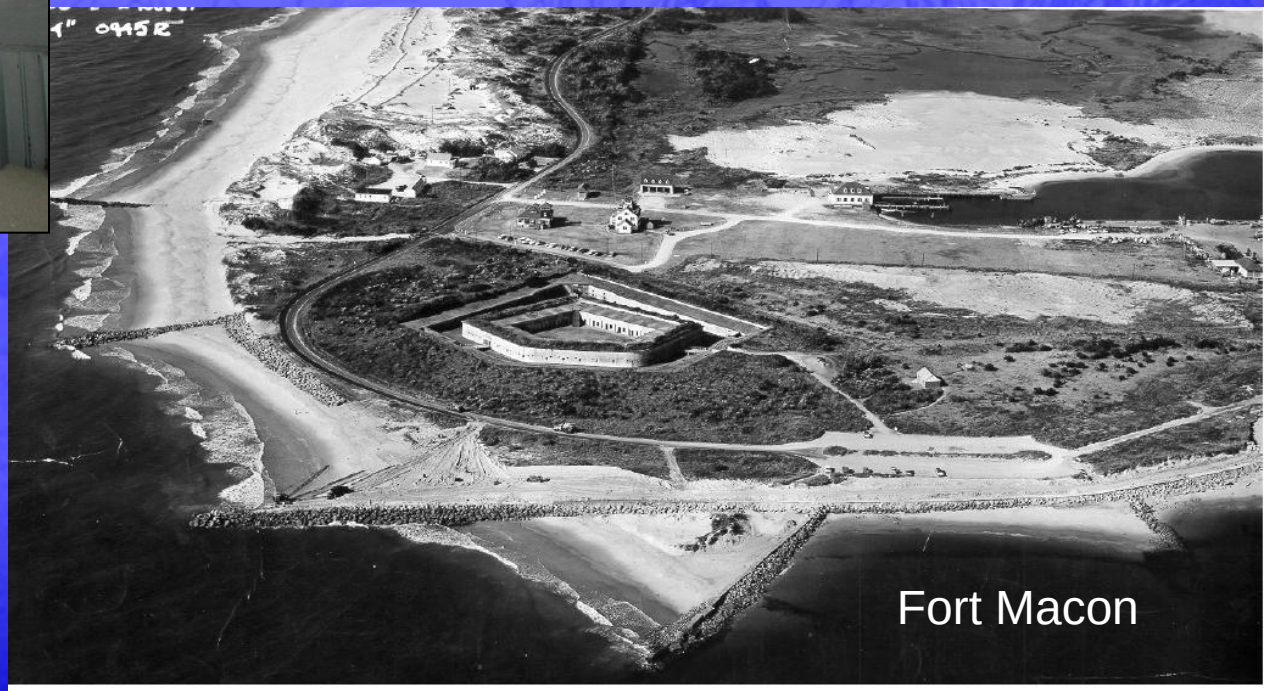
Masonboro Inlet Jetties


Rock (rubble mound)

Natural Coquina Outcropping - Fort Fisher

Alum.Sheet Pile

Steel Sheet Pile


Fort Macon

Low Profile Rock Groin

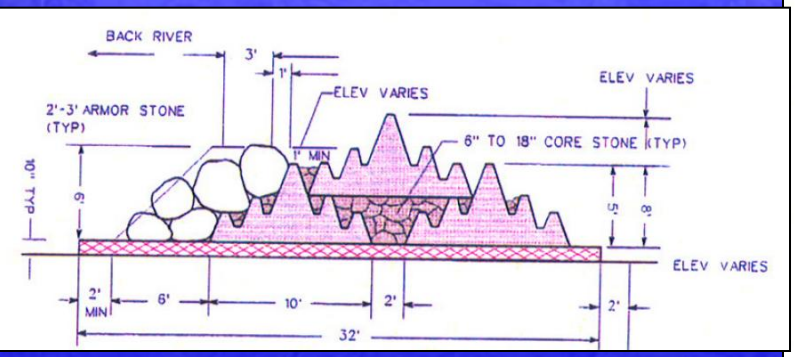
Hunting Island Groins

Groin construction for several recent projects in SC (Hunting Island, Daufuskie Island) have realized costs ranging between $1,000 and $1,500 per foot.

Mitigation Steps for Groins

If monitoring shows groins are adversely impacting downdrift shorelines:

- Place additional sand
- Modify groins (notching, shortening)
- Groin removal as last resort
- Examples: Tybee Island, Georgia; northern NJ (groins >460')

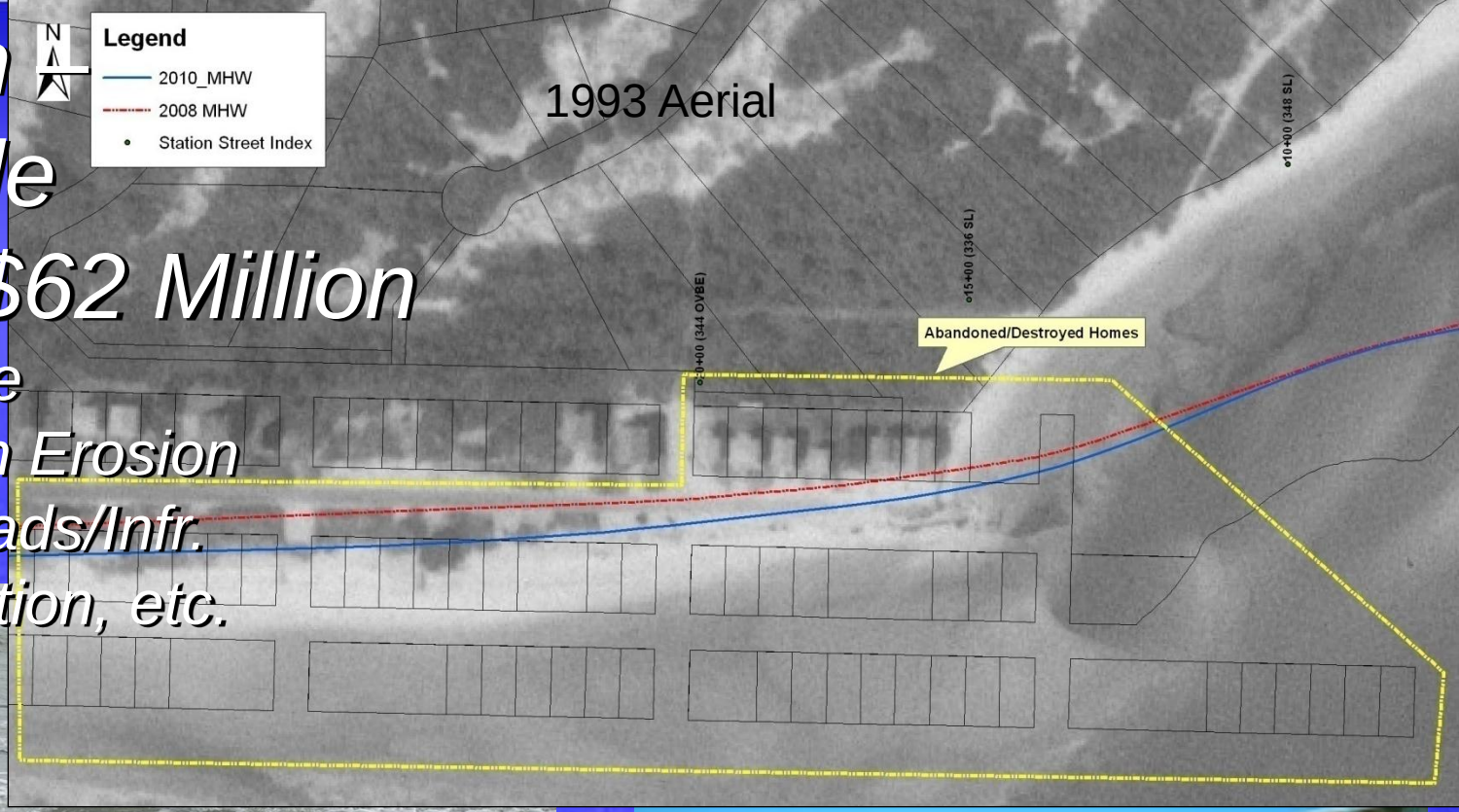


Groin G-1 Looking Toward Ocean. High Tide. Groin L-Head in Distance.

ALTERNATIVES

No Action Ocean Isle 15 yrs = $62 Million

- -Lost Tax Base
- -Private $$ On Erosion
- -Public $$ Roads/Infr.
- -Utility Relocation, etc.



Road/Structure Debris Remains

1995-2001, 24 homes have been lost to erosion on Holden Beach

Road/Structure Debris Remains

NO ACTION

NO ACTION

THREATENED STRUCTURE RELOCATION

Table 1: Nags Head Estimated Structure Relocation Costs

Structure Relocation Alternative	Estimated Cost/House
Relocate house to non-oceanfront lot (including condemned property losses and new property acquisition)	$1,579,000

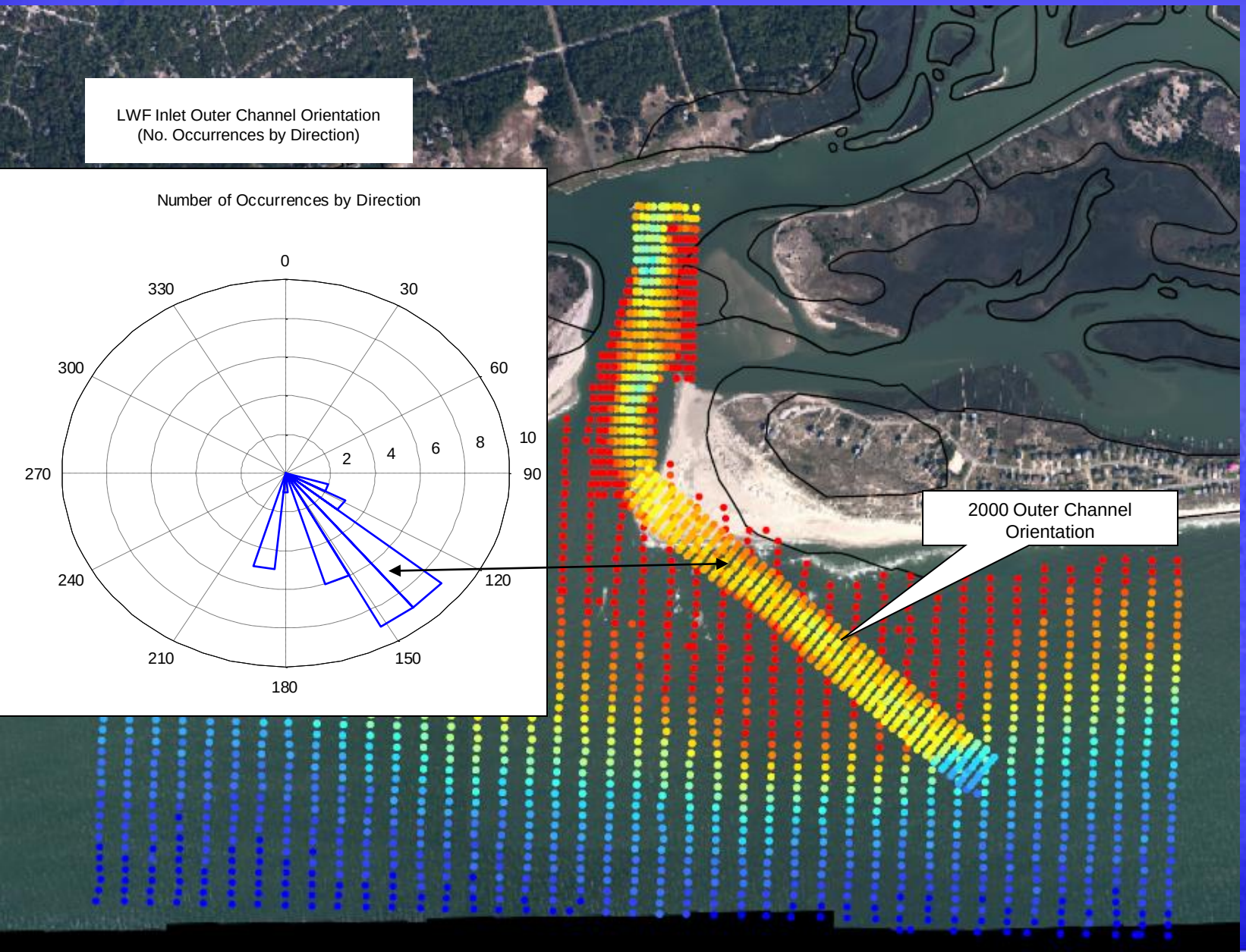
Note: Estimates based on 1,350 ft^2 footprint (therefore a two story structure can be estimated as 2,700 sq ft.) (CSE, 2006).

PROPERTY BUYOUTS

Salvesen (2004) buy-out programs can have disadvantages including:

- High Up-Front Cost
- Reduces Local Tax Base
- Disrupts Neighborhood
- May Increase Housing Costs (in short term)
- Incomplete Participation Limits Effectiveness
- Higher Costs of Replacement Housing

“Inlet” vs “Channel” Relocation



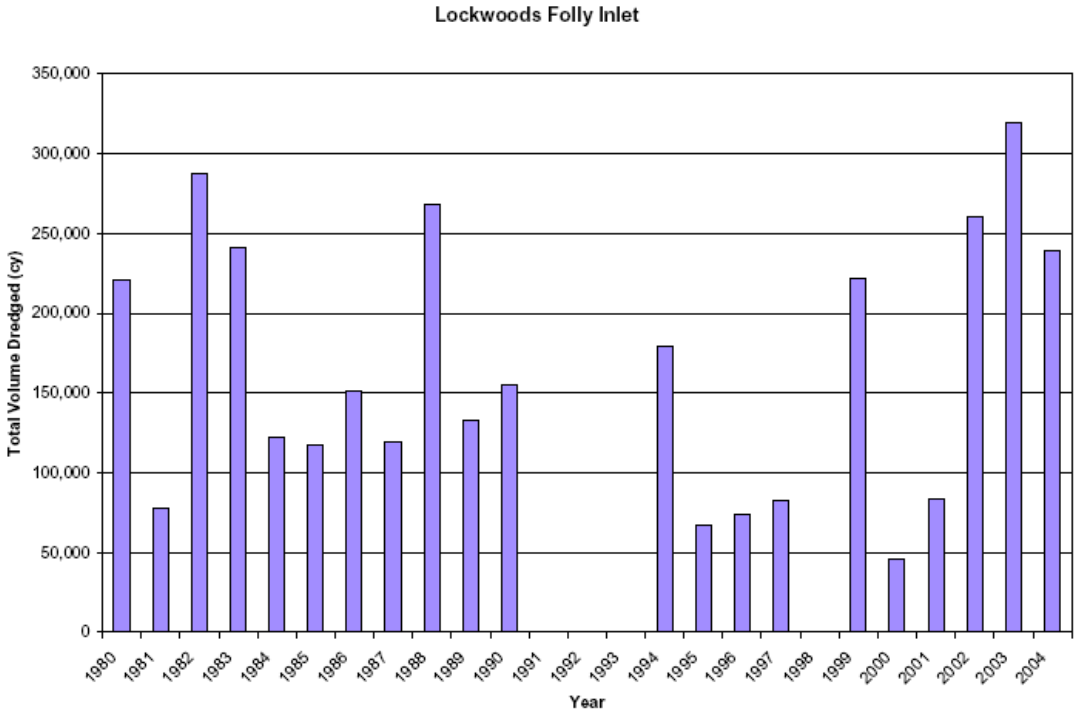
Excerpted Table from Shallow Draft Inlet report

Table VII-2. Dredge Capabilities and Limitations by Type

Factor	Dredge Type		
	Sidecaster	Special Purpose – Small Hopper	Pipeline (cutterhead)
Range of Depth for Dredging	6 to 25 feet	6 to 25 feet	12 to 50 feet or more
Material Placement	Discharges to side of channel	Bottom dump - can transport sediment to nearshore waters, storage sump, or offshore disposal site	Pump to nearby location in-water or onto land
Ease of Deployment	Mobile, flexible	Mobile, flexible	Not self-propelled, pipeline must be installed
Environmental Windows	All Year	All Year	Nov. 16 – Apr. 30**
Wave Conditions	Ocean inlet capable	Ocean inlet capable	Restricted depending on wave size (Typically 3-4 ft.)
Approximate Average Daily Production (cy/day)	4000	1900	3500 (depends on size and downtime)
Approximate Average Cost per cy*	$2.38	$4.31	$6.88

* Costs based on most recent five years (FY 2000-2004)

** Beach and upland placement are restricted due to bird and turtle nesting and habitat considerations (see Regulatory Costs section)



NC Shallow Draft Report

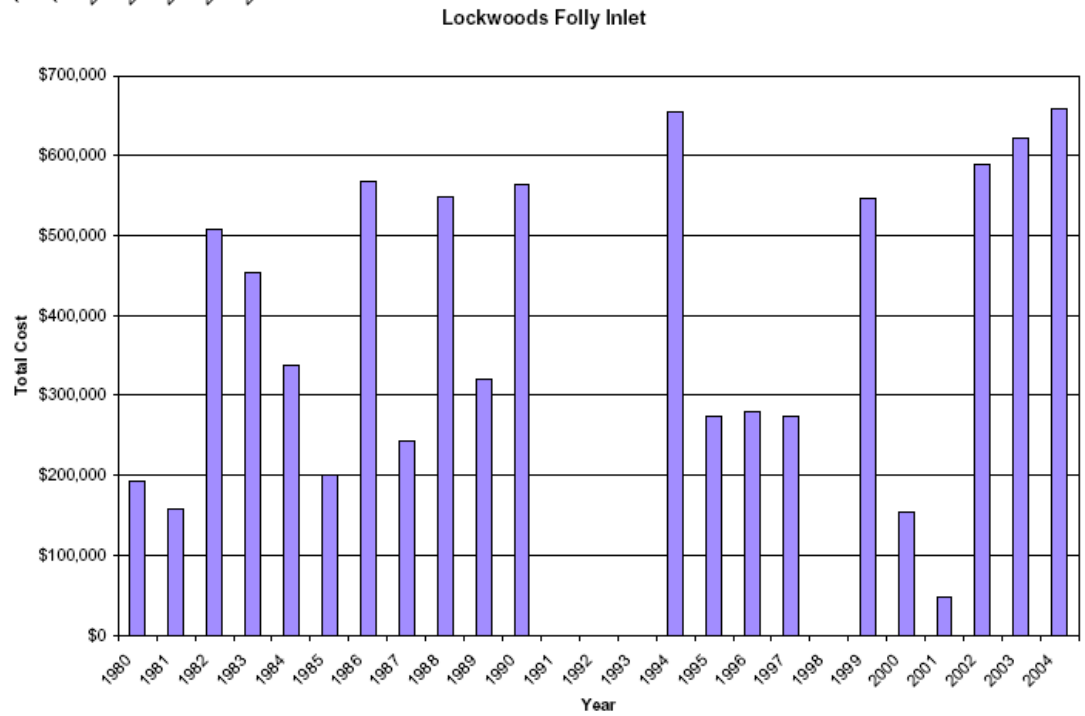


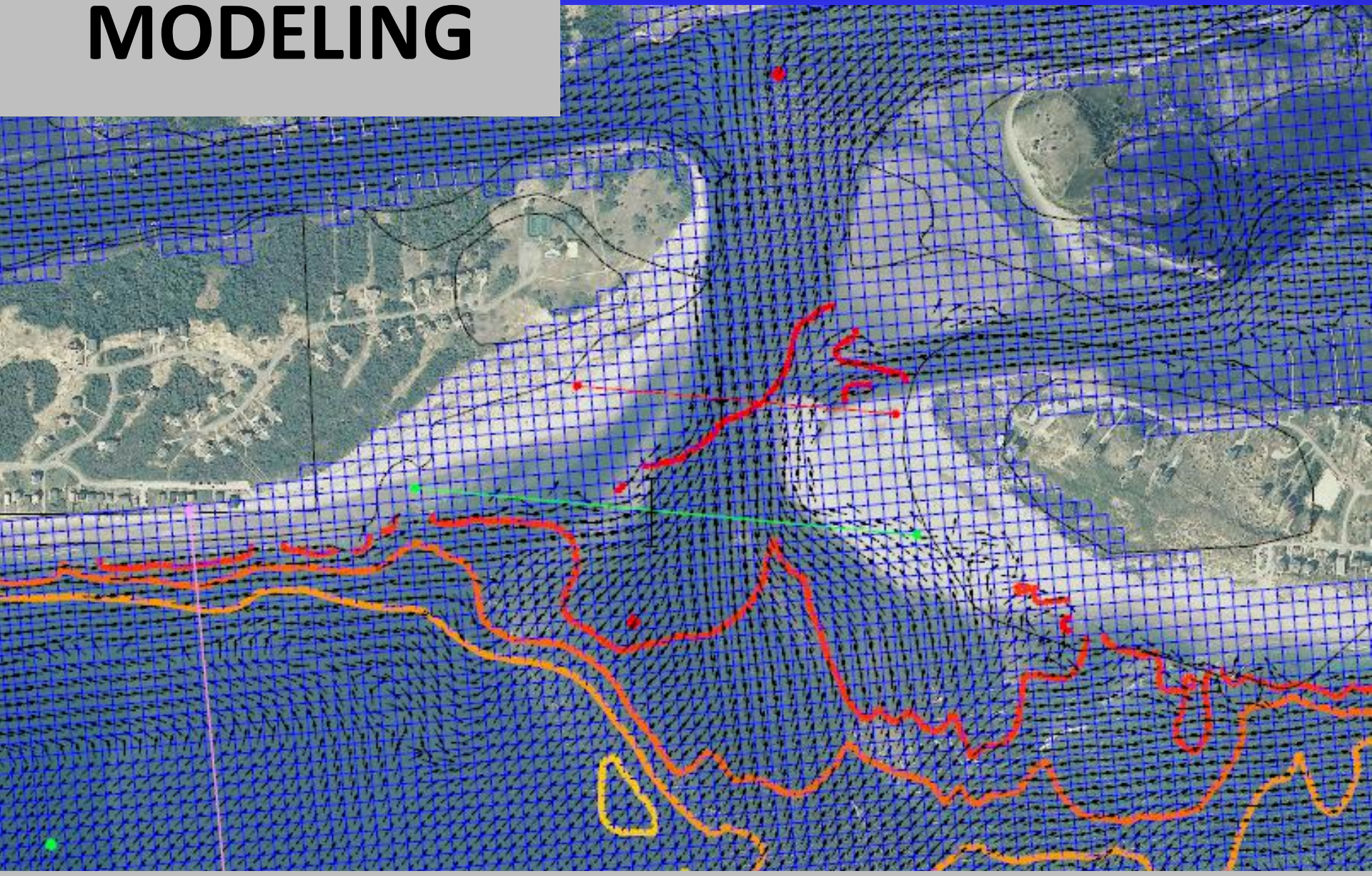
Table 3. Summary of Holden Beach Nourishment Projects since 2001

Date	Completed By	Beach Stations Nourished	Approximate Volume of Material Placed (cubic yards)	Nourishment Material Source
'CENTRAL REACH' PROJECTS				
12/8/01 – 2/20/02	USACE	87+00 – 192+00	525,000	Wilmington Harbor Deepening Project
3/7/02 – 4/30/02	Town of Holden Beach Phase I	66+00 - 90+00, 175+00 – 217+00	141,700	Upland - Oyster Harbor site
Winter 2002-2003	Town of Holden Beach	90+00 – 175+00	30,000	Upland - Boyd Street Disposal Area
12/03 – 4/04	Town of Holden Beach	46+00 – 68+00 and 215+00 – 238+00	123,000	Upland - Smith borrow site
Early 2006	Town of Holden Beach	Eastern Reach	42,000	Upland - Smith borrow site
Early 2006	Town of Holden Beach	Western Reach	3,200	Upland - Smith borrow site
1/24/08 – 3/28/08	Town of Holden Beach	60+00 – 95+00 and 245+00 – 270+00	201,000	Upland - Smith borrow site
03/24/09 – 4/30/09	Town of Holden Beach	55+00 – 110+00 and 210+00 – 255+00	190,000	Upland - Smith borrow site
'EAST END' PROJECTS				
3/02-4/02	USACE	20+00 – 30+00	32,000	Lockwoods Folly Inlet crossing of AIWW
9/16/04 – 11/2/04	USACE	15+00 – 40+00	113,230	Lockwoods Folly Inlet crossing of AIWW
5/5/06 – 5/24/06	USACE	15+00 – 40+00	62,853	Lockwoods Folly Inlet crossing of AIWW
2008/2009	USACE	20+00 – 40+00	100,000	Lockwoods Folly Inlet crossing of AIWW
April 2010	USACE	20+00 – 55+00	140,000	Lockwoods Folly Inlet crossing of AIWW
February 2011	USACE	20+00 – 40+00	32,000	Lockwoods Folly Inlet crossing of AIWW
Jan-12	USACE	20+00 – 40+00	25,000	Lockwoods Folly Inlet crossing of AIWW

Conceptual Alt 1 with Nourishment

Conceptual Alt 2 with AIWW Corps Maintenance

MODELING

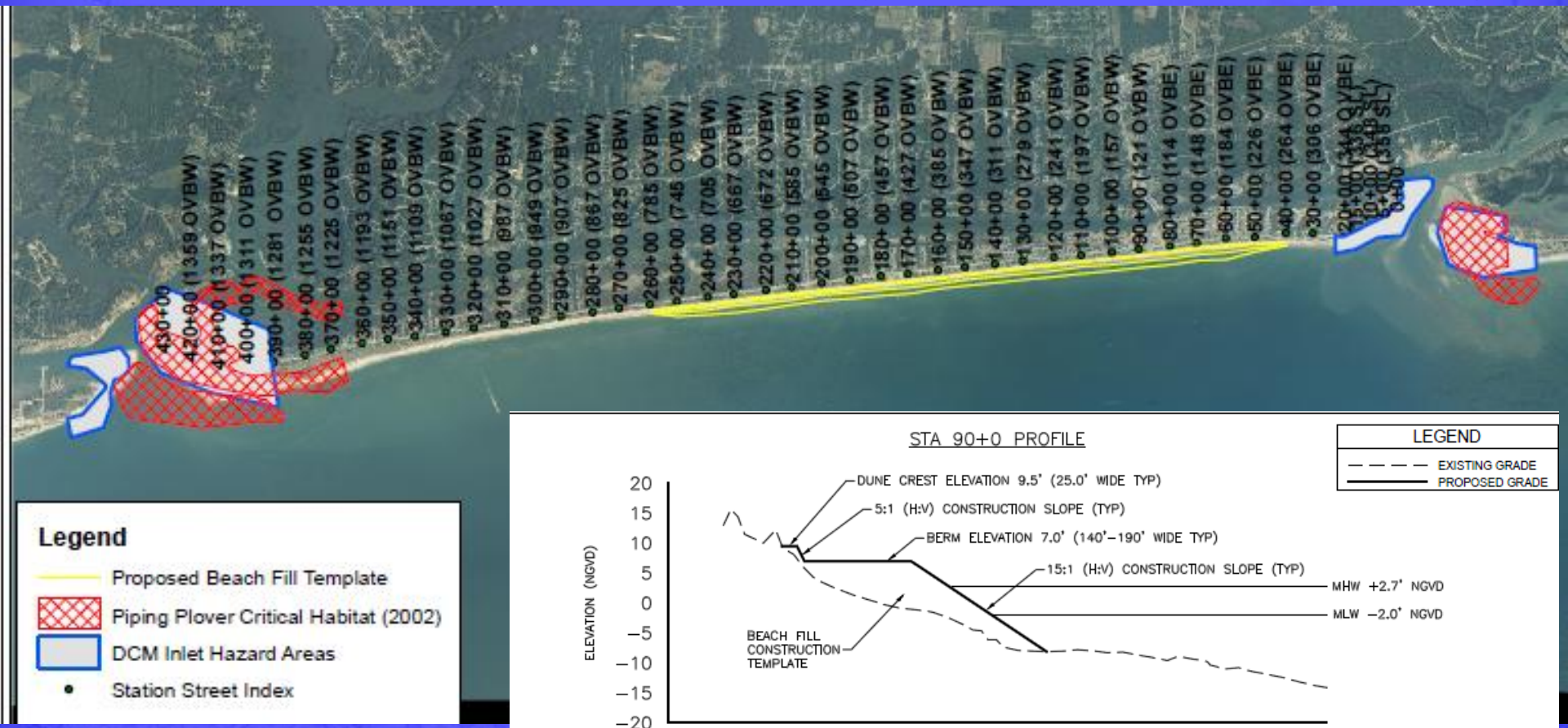


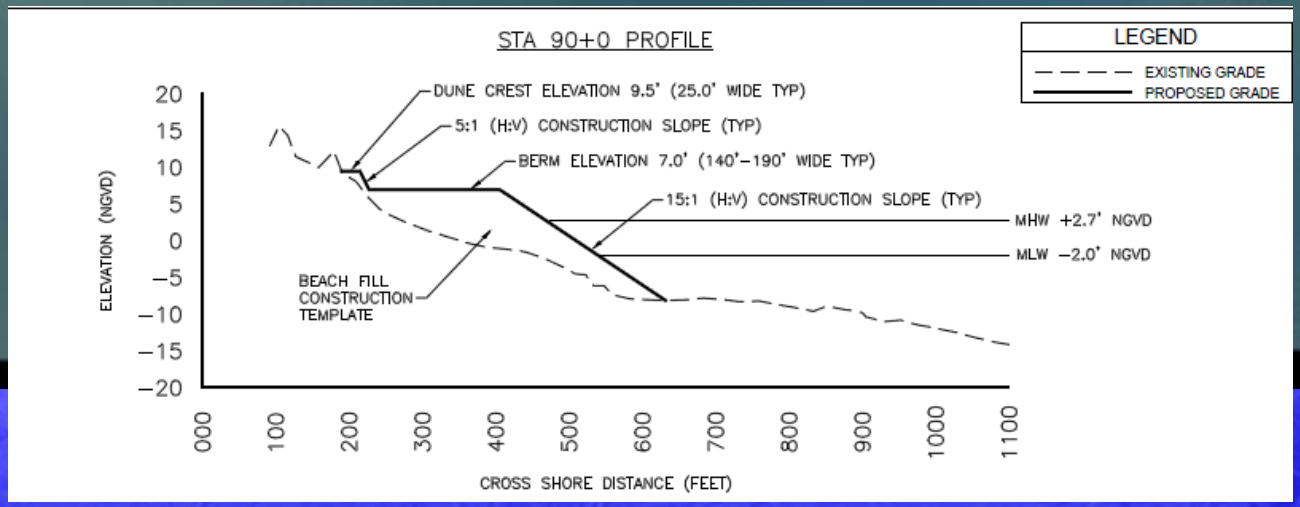
- Wave, Hydrodynamic & Sediment Transport

Extra Slides

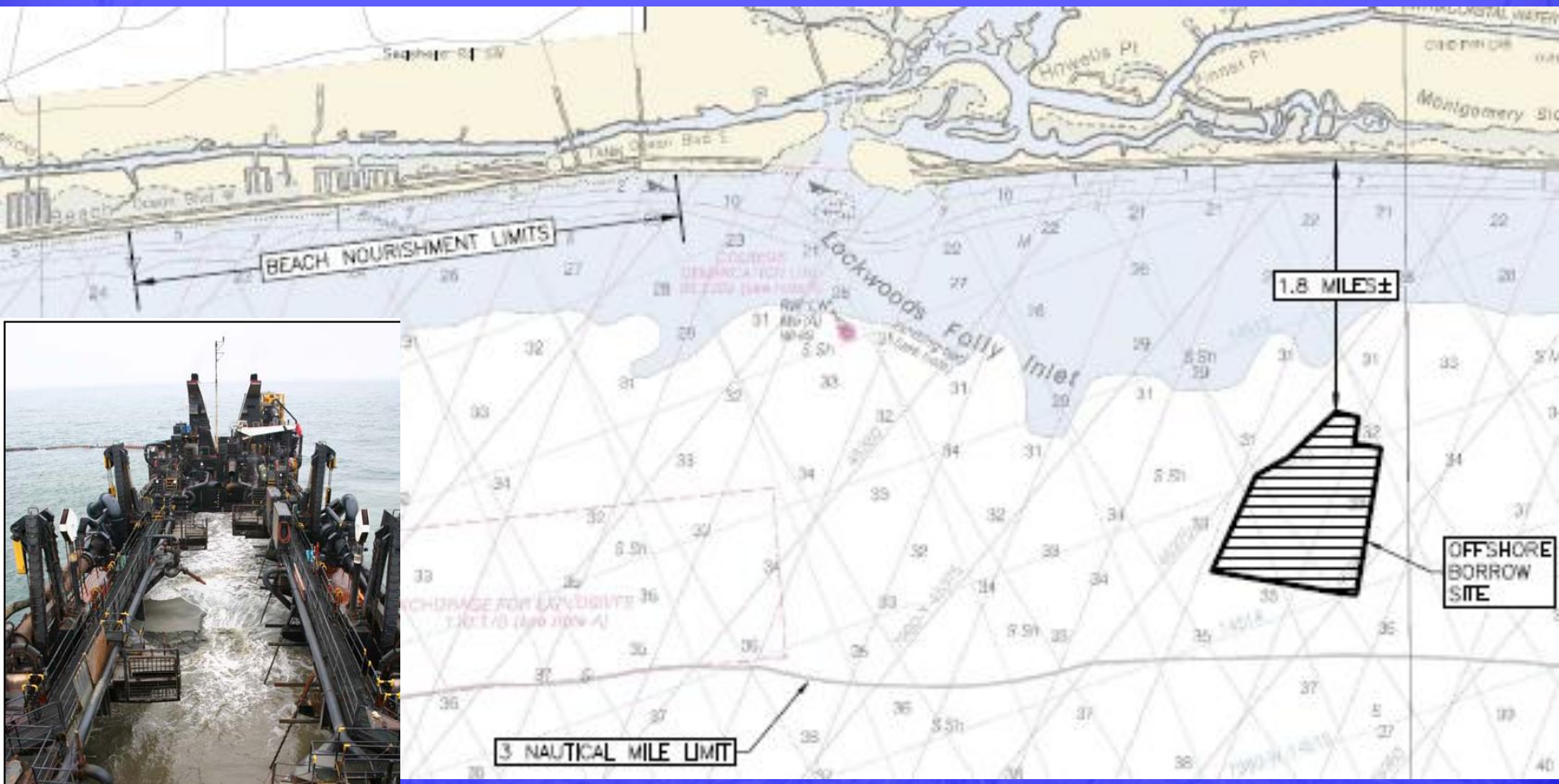
CENTRAL REACH PROJECT

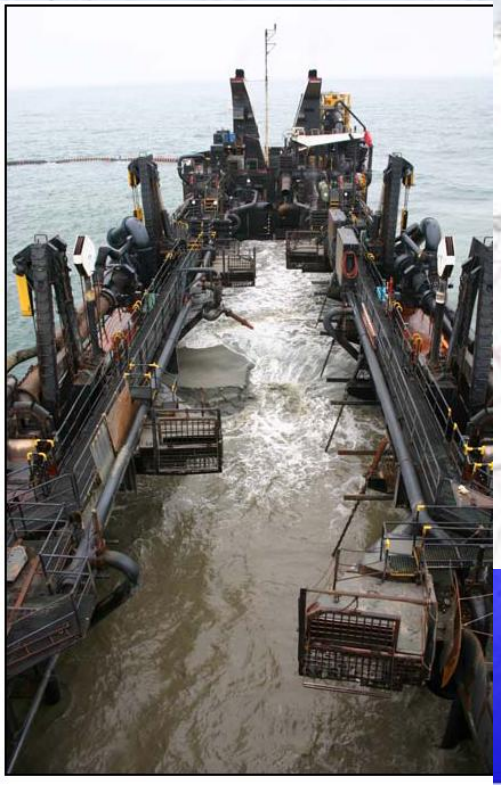
- 1.31 MCY over 22,000 ft (OBE 262 to OBW 781)





CENTRAL REACH BORROW AREA





- Enough Sand for 2-4 Large Scale Projects
- Average 3.5 ft cut depth